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LETTER
FROM
THE SECRETARY OF WAR,
TRANSMITTING

*The report of the commission to examine and report upon the Sutro Tunnel,
in Nevada.*

JANUARY 9, 1872.—Referred to the Committee on Mines and Mining and ordered to
be printed.

WAR DEPARTMENT,
January 6, 1872.

The Secretary of War has the honor to submit to the United States Senate and House of Representatives the report of the commission appointed by the President, under act of Congress approved April 4, 1871, to examine and report upon the Sutro Tunnel, in Nevada.

WM. W. BELKNAP,
Secretary of War.

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., January 4, 1872.

SIR: I transmit herewith the report and accompanying papers of the commission appointed under the authority of the act of Congress approved April 4, 1871, "to examine and report upon the Sutro Tunnel, in the State of Nevada, authorized to be constructed by an act of Congress approved July 25, 1866, with special reference to the importance, feasibility, cost, and time required to construct the same; the value of the bullion extracted from mines on the Comstock lode; their present and probable future production; also, the geological and practical value of said tunnel as an exploring work, and its general bearing upon our mining and other national interests in ascertaining the practicability of deep mining."

The report presents the views of the commission briefly and clearly.

Under the head of *importance of the tunnel*, the commission is of the opinion that the tunnel is not a necessity for ventilation or drainage, but that any scheme which promises increased economy in working the mines and rendering valuable the vast amount of now worthless low-grade ores in the Comstock lode, becomes of national importance. Whether the Sutro Tunnel project fulfills this condition of economy depends, in the opinion of the commission, upon the practicability of securing a sufficient water-power from the Carson River, at all seasons, for the reduction of the ores, and upon the efficacy of the methods

employed in Germany and other countries in Europe for the concentration of ores. On the first point the commission has no doubt. On the second it has not been able to obtain the desired information.

On the *feasibility of the tunnel*, the opinion of the commission is in favor of the entire feasibility of the project, so far as its construction is concerned.

The *cost of the tunnel*, the branch and all the shafts, is estimated at \$4,418,329 50 in gold.

The *time of completion* is estimated at three and one-half years, which may be reduced to two and one-third years, if machinery be judiciously employed.

The *value of the bullion* extracted from the mines of the Comstock lode, according to the information the commission was able to gather, is \$125,000,000.

The *present annual production* the commission place at \$15,000,000.

As regards the *probable future yield*, the commission says:

No claim can be made to anything like accuracy, except in the few instances in which ore-bodies are now developed. The commission has already stated its belief in the lode being what is known as a true fissure-vein, or as continuing downward indefinitely in the crust of the earth; but whether the vein will continue to be ore-bearing cannot be predicted with any degree of certainty. It is a matter of opinion, to be based, however, upon probabilities and the actual results experienced in deep mining in other parts of the world. These, in the judgment of the commission, favor the finding of ore down to the lowest depths that can be reached; and that this opinion is shared by most of the mining authorities, seems to be shown by their continued downward search.

The report concludes with the opinion that, as an exploring work for deep mining, the Sutro Tunnel may justly claim favorable consideration.

The information to be obtained from an examination by a commission of the methods followed in the mines of Germany and England, appears to be of such importance as to recommend itself to the favorable consideration of Congress.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier General and Chief of Engineers.

The Hon. the SECRETARY OF WAR.

REPORT OF THE SUTRO TUNNEL COMMISSION.

OFFICE SUTRO TUNNEL COMMISSION,
New York, December 1, 1871.

GENERAL: I have the honor to forward herewith the report of the Sutro Tunnel commission, and in separate packages, the following:

Package containing maps, plans, and drawings, marked from 1 to 11, inclusive.

Package containing estimate, circular letter, reports of superintendents of mining companies, &c., marked from A to L, inclusive.

The special information asked for by Mr. Sutro was received in time to be used in making the report; but the papers which he was requested to furnish, inasmuch as the opponents of the project had been invited to do the same, has not come to hand. It may be expected daily, and

when received will be forwarded with request that it be added to the papers accompanying the report.

Very respectfully, your obedient servant,

Trans:
Lit

H. G. WRIGHT,
*Lieutenant Colonel of Engineers, Brevet Major General,
Senior Officer of Commission.*

Brigadier General A. A. HUMPHREYS,
*Chief of Engineers, United States Army,
Washington, D. C.*

OFFICE SUTRO TUNNEL COMMISSION,
New York, November 30, 1871.

GENERAL: The commission appointed under the authority of the act of Congress approved April 4, 1871, "to examine and report upon the Sutro Tunnel in the State of Nevada," having completed the duties assigned to it under said act, has the honor to submit the following report:

The members of the commission met in this city, in pursuance of your instructions, on the 9th of June, and after organizing and making the necessary preliminary arrangements, including a visit to, and examination of the Hoosac Tunnel in Massachusetts, proceeded to Nevada, arriving at Virginia City on the 29th of that month, and at once entered upon the duties with which they were charged. From that date to the 7th of August the commission was constantly occupied with its investigations, during which period it examined pretty thoroughly the mines on the Comstock and other lodes in the vicinity, the country in the neighborhood within a general radius of fifteen miles, with a view to ascertaining its topographical and geological character, and conferred with the mining authorities, miners, and others interested in the great and almost sole industrial interest of that section of Nevada.

Every facility was afforded the commission by the mining authorities and the people generally; the desire seeming to be on all hands to give the opportunity for a full and complete investigation of a subject in which the entire community was so deeply interested. To the superintendents of the various mines the commission is especially indebted for the large mass of information afforded by them, both verbally and in writing, in relation to the mines under their control. The latter portion will be found in their reports in the appendix, made in response to the interrogatories of the commission, a copy of which is also appended. To those papers frequent reference will be made in the course of this report. Mr. Sutro, the projector of the tunnel, was also present during most of the time the commission was in Nevada, and was always ready to afford information, and, from his familiarity with the subject, to suggest ready means for obtaining information from other sources.

The duties of the commission, as prescribed by the law under which it was appointed, were, "to examine and report upon the Sutro Tunnel, in the State of Nevada, authorized to be constructed by an act of Congress approved July 25, 1866, with special reference to the importance, feasibility, cost, and time required to construct the same; the value of the bullion extracted from the mines on the Comstock lode; their present and probable future production; also, the geological and practical value of said tunnel as an exploring work, and its general bearing upon our

mining and other national interests in ascertaining the practicability of deep mining."

To the above points the investigations of the commission, although naturally embracing a wide range, were particularly directed, and to them this report will be strictly confined, treating of them in the order in which they are given in the act above quoted.

IMPORTANCE OF THE TUNNEL.

In treating of the importance of this work, it seems proper to give a brief general description of the Comstock lode, referring for an account of its geological character to that part of the report which treats of the "geological and practical value of said tunnel as an exploring work."

The term *lode* is applied to "any regular vein, whether metallic or not, but commonly to a metallic vein," and will in this report be considered as applying to that fissure in Nevada which traverses Virginia City and Gold Hill, and is generally known as the "Comstock." This fissure or rent in the earth has an extent not yet fully developed, but which reaches certainly from the Ophir mine on the north to the Uncle Sam and Overman on the south, a distance of 12,000 feet. Beyond these points the lode is supposed to extend to the north and south to the Seven-mile Cañon in the former direction, and to the American Flat in the latter. It may, therefore, be said that while the fissure itself is believed to have been traced from the diggings known as the Utah mines on "the north to the locality known as the American Flat or "American City" on the south, a length of about 22,000 feet, yet the portion of the lode now worked is comprised between the Ophir on the north and Overman on the south, or a distance of about 12,000 feet, or, say, two and one-quarter miles. This portion of the lode may, as is usually done, be divided into three groups, the "Ophir," the "Gould & Curry," and the "Gold Hill." The two former may be considered as within the limits of Virginia City, the last being in the town of Gold Hill; the two towns being, however, so connected that the stranger is at a loss to determine where one ends and the other commences. Both of these towns rest absolutely upon the lode, and the mine-shafts rise directly in the midst of the streets and houses. The lode has a dip or angle of inclination to the east of about 45° , varying in either direction some 10° . This variation, as might be expected, often occurs within small limits of extent of the vein, but generally keeps within those of 38° and 55° of inclination to the horizon.

The croppings or surface indications of the lode are generally west of the towns of Virginia City and Gold Hill, which, as before remarked, are in most part over the workings of the lode.

In the earlier days of mining upon the Comstock, the work was prosecuted to some extent by means of adits or horizontal tunnels; but as depth was attained, this process was necessarily abandoned owing to the configuration of the country immediately about it, and working by means of vertical shafts was exclusively followed. All the mines of the lode now worked are operated in this manner—that is, a vertical shaft is sunk in the "east country" rock, which, at a depth that can be pretty closely estimated, will reach the lode, and after passing through it into the "west country" rock, is generally continued in the latter upon an angle corresponding with the inclination of the west wall at the point of junction. From these shafts at various depths or "levels," usually about 100 feet apart, drifts or small tunnels are run horizontally in various directions through the lode to ascertain its ore-bearing char-

acter; and through them the ore and débris are brought to the shafts and raised to the surface by steam-power. The water met with in the workings is pumped to the surface through these shafts by the agency of same steam machinery, and air for ventilation is forced by blowers down the shafts, through wooden boxes, and distributed through pipes to the various working headings.

The ore thus brought to the surface is taken from the "dumps," in which it is first deposited, by wagons or railway-cars, and transported to the mills for reduction. These mills are scattered over the country wherever water is to be found, the greatest distance being about eighteen miles. With the exception of those on the Carson River, which are run by water-power, these mills are worked by steam; the water to be obtained being sufficient for the purposes of reduction only, and not for power. Indeed many of these steam-mills were idle during our visit, for the want of water, and the water-mills on the Carson River were generally working up to a part only of their capacities for the same reason.

In the early days of mining on the Comstock lode, several excellent wagon-roads of easy grades were constructed, leading to the mill-sites and to the sources of supply of the lumber and the fuel needed in the working of the mines; but these are now in a great degree supplanted by a railroad recently constructed from Virginia City to Carson City, passing through Gold Hill, and having branches leading to the principal reduction-works. By this road a large part of the ore extracted from the mines is transported to the mills, and most of the lumber and wood used for mining purposes is brought back on the return trips. This road, which is a fine example of railway engineering over a different country, is about twenty-two miles in length, not including its branches, and is reported to have cost about \$2,000,000. It is about to be connected with Reno, a station on the Central Pacific Railroad, by an extension from Carson City to the latter point, but at the time of our visit its principal business was the transportation of ore from the mines to the mills, and of lumber and fuel for the supply of the mines.

One of the objects of the tunnel, as will be seen further on, is to change almost wholly the mode of working the mines just described. The tunnel, which is to be nearly rectangular in cross-section, having a height of 12 feet, with a width at bottom of 14 feet, and at top of 13 feet, commences at a point in the valley of the Carson River, and running in a direction nearly perpendicular to the Comstock ledge, is to intersect it at a level of $1,898\frac{1}{2}$ feet below the point of the croppings, marked A on the map, to which the various levels of the mines are referred. At or near this point of intersection a cross-tunnel of similar dimensions is to run along the ledge, and to communicate with all the mines. A commencement of 70 feet only in length has been made on the main tunnel, more with a view to showing what is designed than for any other purpose, and a drift six feet by seven in cross section had been extended under the intervening mountains about 2,300 feet at the time of our visit. It is understood that this length had been increased to 2,530 feet on the 14th of November. The map No. 1, herewith, of the country in the vicinity of the Comstock, shows the positions and directions of the main and cross tunnels, and the sheet marked No. 2, a section and profile of the grounds on the line of the tunnel. The cross section of the tunnel and of the drift or preliminary tunnel, upon which work is at present prosecuted, are shown on sheet marked No. 3. The length of the main tunnel will be 19,790 feet, or about three and three quarter miles, and the cross tunnel, if extended only so far as to include

the mines now being worked, about 12,000 feet, or about two and one-quarter miles. Should the ledge north of the Ophir and south of the Uncle Sam and Overman be again worked, the cross-tunnel must be increased in length correspondingly. In our estimates of costs we have considered the main and cross tunnels separately, and have restricted the latter to the limits of the Ophir on the north and the Uncle Sam and Overman on the south. Drawings exhibiting plans of all the mines within the above limits will be found with this report, marked 4, 5, 6, 7, 8, 9, 10, and 11.

The principal advantages of the proposed tunnel in relation to the mines, as claimed by Mr. Sutro, may be stated briefly as follows.

1st. The improved ventilation of the mines, resulting from the current of air which, entering the tunnel at its outer extremity, and passing through it and up into the mines and out at their present shafts, will so cool and purify the heated, stagnant atmosphere of the drifts and stopes as to preserve the health of the miner, and enable him to accomplish a greater amount of labor than would otherwise be possible.

2d. The drainage of the mines above the level of the tunnel—an object which is now accomplished by means of costly machinery and at great expense. On the connection of the tunnel with a mine, the water in the latter would discharge itself without the intervention of machinery and without cost.

3d. A largely increased economy in the working of the mines by taking the ore through the tunnel to reduction works at its mouth, instead of raising the same to the surface and transporting it, often to a much greater distance, to the mills now established.

4th. Its value as an exploring work in cutting at considerable depths several mineral veins or lodes known to exist to the eastward of the Comstock, all of which have been, and at some points continue to be, worked for the precious metals; also, in a geological point of view, in determining the depth at which precious ores will be found in our country in what may be considered as true fissure-veins.

These claims on the part of the advocates of the tunnel will be considered in the order in which they have been stated, with the exception of the last, which can be more properly treated under the head of "the practical value of said tunnel as an exploring work."

VENTILATION.

At the time the tunnel was projected, and the act of Congress of July 25, 1866, was passed, the mines on the Comstock lode were undoubtedly much embarrassed in their operations by the lack of proper ventilation. The atmosphere in their stopes and drifts was hot and stagnant, and any relief, such as was promised by the tunnel, might well be viewed as indispensable by the mining authorities and miners to the further prosecution of their search for the precious metals. A stagnant atmosphere and a temperature of over one hundred degrees might well occasion misgivings of success in their attempts upon the lower and therefore hotter levels. At that time each mine was worked independently of the others, upon its own ground, with its single shaft forming the only communication between its stopes and drifts and the surface. Without the aid of mechanical ventilation, it is not surprising that, at a depth of three or four hundred feet even, the air of the mines should have severely taxed the miner's powers, and induced the belief that further search into the heated bowels of the earth would be impossible,

unless some artificial aid, such as the proposed tunnel promised to afford, should be provided.

But this very necessity for an improved and increased ventilation indicated one of the means by which it might, in a great degree at any rate, be accomplished. The drifts of contiguous mines were connected together, an air current was established down the shaft of one and up the other, passing in its transit through such of the drifts, stopes, and winzes as were between them, thus purifying and cooling the atmosphere in those parts of both. For the portions of the mines which were influenced imperfectly or not at all by the current of air thus established, recourse was had to blowers operated by the steam-power employed in hoisting. By means of these blowers air could be forced through pipes to all parts of the mines not affected sufficiently by the natural ventilation established by the subterranean connection just alluded to. At the time of our visit, the mines were generally well ventilated, and the miners with whom we conversed did not complain; and in the cases in which a more effective change of air was needed, steps were being taken to accomplish it.

It is, therefore, the opinion of the commission that, while the proposed tunnel would increase and improve the ventilation of the mines and possibly dispense with the use of some part of the means for artificial ventilation now employed, it is not a necessity for ventilation. Even with all the aid that the tunnel can be expected to afford, it is the opinion of the commission that mechanical ventilation by blowers, operated by steam or other power, would still be needed at the headings and in the stopes where the air from the tunnel would not penetrate.

According to natural laws as at present understood and received, the air entering the proposed tunnel would pass through it and up the shafts of the mines by the easiest and therefore by the most direct channels, thereby conferring little if any benefit upon the stopes and drifts not in the line of such direct transit. Hence the necessity which is assumed for a continuance of mechanical ventilation for certain portions of the mines after the completion of the tunnel.

And here it may be proper to allude to certain anomalies observed in the ventilation of the mines on the Comstock lode, as well as in mines upon lodes lying to the eastward. According to the received laws of ventilation it would have been assumed that, in the case of two shafts connected at bottom by drifts, the air current would pass down the lower and through the drifts up the higher, and that this rule would be without exception where not influenced by circumstances of situation or artificial causes; that, in the case of a long adit or tunnel, the inner extremity of which was connected with the surface by a shaft, the outer being directly upon the side of the mountain, the current would be through the tunnel and up the shaft. In the former case the current was found to be sometimes in one direction and sometimes in the other, it having been permanently changed in one instance, after the occurrence of a fire in one of the mines thus connected; the down-draught having been through the shorter shaft before the fire, and through the longer ever since. In the latter case, which applies to two tunnels visited by the commission, the down-draught was into and downward through the shafts and out of the tunnels in a very strongly perceptible current. In view, therefore, of these anomalies, it would seem uncertain whether the current of air would pass through the proposed tunnel into the mines and out through the shafts, or the reverse. So far as the ventilation is concerned, it will be of little importance which way the current should pass. Probably the mines would be the

more benefited by its passing downward through them and out of the tunnel than in the reverse direction.

DRAINAGE.

In the early days of mining upon the Comstock, much trouble was experienced from water which accumulated in the mines, and occasioned the necessity for powerful and expensive machinery for drainage. When, therefore, the tunnel was proposed, it was looked upon as an important accessory to further mining operations in affording a ready and effective means of draining the ledge without the recourse to costly mechanical contrivances. It was then assumed, naturally enough, that the lower the depth the greater the amount of water to contend against, and serious doubts appear to have been entertained of the possibility of freeing the mines from water by mechanical means. The construction of the tunnel seemed, therefore, a necessity. But as greater depths were attained it was discovered that the water, instead of permeating the earth to an indefinite extent, was mainly confined to near the surface; that below a few hundred feet it was struck in limited quantities only. It was also discovered that this water, instead of being generally diffused, was collected in pockets bounded by impermeable seams of clay, which, when pierced, had only to be drained to exhaust the supply. As the mining operations have increased in depth, these pockets or reservoirs have become less frequent and formidable, till in many of the deepest the water is not only not troublesome, but is found in less quantity than is needed for the purposes of the mines themselves, thus necessitating the purchase of water from the company which furnishes the same to the inhabitants of Gold Hill and Virginia City, or from other and wetter mines. By reference to the statements of the superintendents, appended to this report, it will be seen that the cost of pumping for all the mines did not, probably, exceed \$150,000 for the past year, and that in some of them there was no water at all. This sum exceeds that arrived at by the commission—viz, \$124,674—which was obtained by taking the costs as given for the mines, so far as reported, and estimating for the others.

Taking, then, the observations of the commission in connection with the statements of the superintendents of the mining companies, we are of the opinion that the tunnel for this purpose alone is not a necessity for the drainage of the Comstock lode. That it will effectively drain all those with which it shall be connected is obvious; but the same result can be attained by present means at less cost—a cost which, moreover, promises to become still smaller as the mines progress in depth.

ECONOMY OF WORKING, ETC.

Under the present system of operating the mines, the ore and the refuse rock are raised to the surface through the shafts by steam-power, the ore being transported to the mills by wagons or by the railroad before alluded to, and the refuse rock deposited at the dumps contiguous to the shafts. The items of expense, as given by the superintendents, vary somewhat, as might have been expected, in view of the different circumstances in each. The average of certain of the more important of them may, however, be stated with sufficient accuracy, as follows:

Cost per ton of hoisting from depths varying from 1,250 to 1,750 feet, being the average reported for seven of the principal mines of the lode	\$0 51. 17
Cost of pumping for the year ending June 30, 1871, as arrived at by the commission, by taking the cost of the mines as far as reported and estimating for the rest	124, 674 00

The superintendent of the Ophir mine, a very intelligent man, estimates the total cost for pumping on the Comstock lode for the past year as not exceeding..... \$150,000 00

If we assume what appears from the reports and from other sources as an average yield of the mines—viz: 365,600 tons annually—the cost for certain items of expense by the present method of working will be as follows:

Hoisting 365,600 tons of pay ore, at 51.17 cents.....	\$187,077 52
Transportation of same to mills, at \$1 50.....	548,400 00
Pumping for last year, (commission's estimate)	124,674 00
Hoisting and lowering 3,000 miners, at 8 cents each way, or 16 cents each.....	175,000 00
Total	<u>1,035,151 52</u>

In the above statement the cost of hoisting the refuse rock from the drifts, winzes, &c., is not included, as the quantity is wholly indeterminate, being the greatest in those mines where prospecting alone is being carried on, and the least in those which are working upon ore bonanzas. Indeed, in the latter the amount of débris is inconsiderable. It would be of the highest importance to a full and accurate comparison of the cost of working the mines by the present method and by the tunnel, to introduce this item, as it is very considerable, and the expenditure per ton for hoisting it is the same as for ore; but this seems quite impossible, owing to the indefiniteness of the quantity of refuse removed from the mines.

In considering the cost of operating the mines by the tunnel, it must be stated that, under the provisions of the act of Congress approved July 25 1866, the tunnel company is authorized to collect from all the companies mining upon the Comstock lode a royalty of \$2 per ton for each and every ton of ore taken from the mines after the tunnel shall be connected with them, whether the tunnel be used by the mines or not; that a tariff of 25 cents per ton per mile (or such lesser sum as may be agreed upon) for the transportation through the tunnel may be established; also a charge of 25 cents each way for every man connected with the mines who is carried through the tunnel. The cost of working the mines through the tunnel, as compared with the same items as given above for working by the present method, may then be stated as follows:

Lowering 365,600 tons pay-ore to tunnel level, at 10 cents.....	\$36,560 00
Transportation of same an average of five miles, at \$1 25.....	457,000 00
Transportation of 3,000 workmen, at 50 cents—\$1,500 per day	547,500 00
	1,041,060 00
To this should be added the royalty of \$2 per ton, which for the average production of 365,600 will amount to	731,200 00
Which makes a total of.....	<u>1,772,260 00</u>

The item of drainage is not included in the above, as the tunnel will thoroughly drain all the mines connected with it without cost. This is not a favorable showing for the economy of working by the tunnel, but it should be stated that while the act of Congress authorizes the tunnel company to make a charge of 25 cents per ton per mile for transportation of ore, rock, débris, &c., it is claimed by Mr. Sutro that such transportation can be done profitably at 10 cents per ton, and that no higher tariff will be demanded. It is also understood that a similar diminution will be made in the charge for transportation of workmen.

Such reductions in tariff would make a material change in the estimate given above, which would then stand as follows :

Lowering 365,600 tons pay-ore to tunnel level, at 10 cents	\$36,560
Transportation of same an average of five miles, at 50 cents	182,800
Transportation of 3,000 workmen at 20 cents, or \$600 per day	210,000
	<hr/>
Royalty on 365,600 tons ore, at \$2	438,360
	731,200
Total.....	<hr/>
	1,169,560

Even with this reduction in tariff, the balance would be against working through the tunnel when the royalty, which is the most important item, is included, (at lower levels the comparison would be more favorable;) and were there no other considerations to be taken into account, the opinion of the commission would necessarily be against the tunnel in the point of economy of operating the mines.

Before presenting these other considerations it should be stated that not one of the superintendents of mines has expressed himself in favor of a change in the present mode of working; and that some of them have given the opinion, in effect, that should the tunnel, when completed, with all its drifts and branches, be offered free of charge, not one mine on the Comstock would be operated through it, for the reason that the present mode of working would be cheaper and more expeditious. This opinion is, no doubt, founded upon the supposition, as it is indeed stated in one of these reports, that the ore taken through the tunnel to its mouth is afterward to be transported to the present mills, thereby involving a cost for transportation about equal, perhaps, to what is now paid for carrying the ore from the mouths of the shafts to the mills. Were the present mills to be employed for the reduction of the ore brought out through the proposed tunnel, this opinion would, no doubt, be correct, and the tunnel project would have to be condemned. But it is a part, and an essential part, too, of the scheme to have reduction works at the mouth of the tunnel, to be operated by the water-power of the Carson River, by which the cost of the further transportation of the ore alluded to above will be saved. This plan, which is one of the considerations to which we have referred, would involve the suppression of the present mills, or at any rate such of them as now draw their supplies of ores from mines which would use the tunnel, and also seriously injure financially the railroad leading to Carson City, which was built for, and mainly depends upon, the carrying of the ores to the reduction works. So far as the milling interests are concerned this would be of comparatively small consequence, and the machinery requires renewal in large part every two or three years, and the mills would be maintained in the interval with a view to their abandonment on the completion of the tunnel or to the transfer of their machinery to new sites at its mouth. To the railroad, however, the results would be more injurious, as the interests outside of the transportation of ore, timber, and other supplies for the mines, would probably not be sufficient for its maintenance. How far these injuries to vested interests should influence action in regard to the construction of the proposed tunnel, is not for the commission to determine. It is clear, however, that the successful working of the tunnel would have an effect upon the railroad similar to that which the latter has produced upon the very excellent and costly wagon-roads which were constructed to facilitate transportation in the earlier days of mining upon the Comstock.

As has been stated, the tunnel project includes, as an important and,

indeed, inseparable adjunct, the establishment of mills at its mouth, for the reduction of the ore; and in order that these should be separated cheaply and successfully, a sufficiency of water-power is necessary. Water, to some extent, may be counted upon from the drainage through the tunnel, a quantity sufficient, perhaps, for purposes other than motive power, but not for running the mills, the power for which, supposing water only is to be used, is to be had from the Carson River alone.

This stream, which has its sources in the Sierra Nevada Mountains, and is fed almost entirely from its melting snows, is not at all times to be depended upon in its natural condition for a supply of power. Art is here necessary in aid of nature. At certain seasons of the year this river becomes a rushing torrent, overflowing its banks and covering its valley opposite the mouth of the tunnel for a considerable extent; at others, it is reduced to a comparatively insignificant rivulet. When the commission was in Nevada, it was represented to be at about its lowest stage, and all its water, when led into the flumes, was insufficient to run the mills established along its valley to their full capacity.

In carrying out fully that part of the project which requires the establishment of mills at the mouth of the tunnel, it will, therefore, be necessary to secure by artificial aid an adequate supply of water for running them at all seasons of the year—at those times in which the flow is insufficient, as well as those in which the supply is far beyond what is necessary. This, it is believed, may be accomplished by the construction of a high dam across a narrow gorge of the Carson River, some five miles above the mouth of the tunnel, which, by damming back its waters, shall form a lake or reservoir that will afford a supply during all seasons of the year, for operating all the mills required for reduction of the ore which can be taken from the Comstock and from the other lodes which may be intersected by the tunnel. That this can be accomplished, the commission does not entertain a doubt; yet it should be understood that this opinion is based upon observation alone, and not upon its actual survey. It should be here stated, by way of explanation of the reasons why the commission did not institute surveys for ascertaining exactly all the points involved in this connection, was that it did not come within the original project of the Sutro Tunnel scheme, and its importance was not so clearly seen while the commission was in Nevada, as it is at the writing of this report, when the various data, upon which many of its conclusions are founded, have been fully examined and compared. The opinion we have expressed is, however, borne out by the rather imperfect examinations made since our visit by the tunnel company, through the agency of the surveyor general of Nevada. The commission is, however, of the belief that his results are less favorable to the project than a more detailed survey would have shown. The report of the surveyor general, furnished by the tunnel company to the commission, will be found in the appendix.

But should the foregoing be practicable, it still seems necessary to the economical working by the tunnel, as against the present mode of operating the mines, that an improved system of concentration of ores should be established. It is claimed by the advocates of the tunnel that, with an abundant supply of water, concentration works may be put up after the methods followed in the mining regions of Germany and England, by which the refuse matter may be mechanically separated from the valuable ores, so that only one ton in fifty, perhaps, need be subjected to the process of reduction for securing the precious metals. According to the accounts received of the workings of the German mines, ores assaying less than \$5 per ton are mined with profit, and that

in the English mines, in Cornwall, one is worked which produces only three ounces of silver, or say \$3 90 per ton of ore, and two others which yield six ounces and ten ounces respectively, and all at a profit, through improved methods of concentration. The commission has exercised much diligence toward ascertaining the actual facts in regard to these statements, as they are of the highest importance in connection with the question under consideration; and it has visited the Passaic mine, at Franklin, New Jersey, and the Lehigh mine, near Bethlehem, Pennsylvania, where machines, claimed to be constructed after the models employed in Germany and England, are used in the concentration of the ores of zinc, but has found nothing that is applicable to the concentration of the ores of the Comstock lode.

The loss of precious metals in the reduction by the German and English methods is represented to be not exceeding 5 per cent., while in Nevada it is not far from 35 per cent. in milling, with a saving of perhaps 10 per cent. more in the subsequent workings of the tailings and slimes, making less than 75 per cent. in all. The actual loss in reduction, therefore, appears to be more than 25 per cent., which for a production of \$15,000,000 per annum, entails a loss of the precious metals exceeding five millions of dollars, or a loss beyond what would result from the methods referred to, by which 95 per cent. is saved, of at least four millions of dollars annually.

It would appear to be very singular that this saving should not be made in the working of the most important mines in our country, if the statements just referred to are reliable. But it is denied by some of the mining authorities upon the Comstock that this statement is correct, and it was asserted that large sums had been offered in vain for producing like results. Indeed it seems quite impossible, from the information we have been able to obtain, to speak positive upon the subject. A personal examination of the foreign mines referred to by one or more competent individuals is the only sure mode of ascertaining the actual facts, as applicable to the treatment of the ores of the Comstock. Yet some better mode of reduction than is now practiced in Nevada may undoubtedly be devised, which shall secure a part at least of the large amount now lost in the separation of the precious ores from the refuse matter.

Still another consideration appeals strongly for this economy in the working of the ores—in the saving of a large percentage of metal now lost in reduction. Of the bodies of ore, other than those of low grade, now known to exist in the Comstock, the greater part will be worked out before the tunnel will be completed. Whether other bodies will be discovered is a matter of conjecture. That the lode is a true fissure vein is, in the opinion of the commission, beyond question. But whether the vein will continue to be metal-bearing to indefinite depths cannot be stated with any degree of certainty, though, in the opinion of the commission, the weight of reasoning and the experience in mining in other parts of the world largely favor such continuance. But, supposing that no further deposits of the precious metals should be discovered, the tunnel, if constructed, would have to depend upon the working of the large bodies of low-grade ores, which have thus far been passed over as unprofitable under the present expensive system of mining and reduction. That such ores exist in large quantities in the mines, containing from eight or ten to twenty-five dollars per ton, is generally admitted, and seems to be undeniable. Only one of the mining superintendents with whom we conferred doubted this, and his opinion, we are satisfied from other testimony, is erroneous. Ores milling less

than about \$20 per ton, or assaying less than about \$30, cannot be mined with profit under the present imperfect process of reduction and the high price of labor which prevails in the mining districts of Nevada. Economy must, therefore, be sought for before the immense amount of low-grade ores can be profitably worked; and this economy is to be found in improved modes of reducing the ores, including concentration; in the general application of water-power, and in the more general substitution of machinery for manual labor, rather than in a reduction of the present rates of wages. A saving of 95 per cent. of the gold and silver contained in the ore, as is asserted to be the case in the German mines of similar character to the Comstock, would go far toward giving value to the millions contained in the low-grade ores which have been thrown aside or passed over as worthless. While it is not assumed that mining can be carried on as cheaply here as in Europe, owing to the higher value of labor in our country, it is not seen why, in other respects, the cost to us should be greater, provided we adopt the same or improved means in the reduction of the ores. If, therefore, ores assaying but \$5 per ton can be there mined and reduced at a profit, we do not see why ores of the same character assaying \$10 may not be profitably worked with us, with our higher rates of labor. This would render valuable the vast amount of now worthless low-grade ores in the Comstock, and add millions to the world's circulation. Hence the importance to the nation of any scheme which promises increased economy in the working of mines.

Whether the Sutro Tunnel project fulfils this condition of economy depends, in the opinion of the commission, upon the practicability of securing a sufficient water-power from the Carson River, at all seasons, for the reduction of the ores; the possibility of which, though not fully proved by accurate surveys, no doubt is entertained, and upon the efficacy of the methods employed in Germany and other countries of Europe for the concentration of ores, of which we are unable to vouch.

Assuming the correctness of these two points, of abundant water and of concentration of ores, we would express an opinion favorable to the tunnel and its accessories as an economical mode of working the mines of the Comstock; otherwise, we should advise that the mines continue to be operated as at present practiced.

FEASIBILITY OF THE TUNNEL.

Of the practicability of the project there is no doubt. It is a question of cost alone. So many tunnels have been run in this, as well as in other countries, through material much more difficult, that no reasonable grounds exist for questioning the feasibility of the one we are considering. So far as surface indications are to be relied upon, the rocks to be penetrated do not differ materially from those which are met with in the operations on the Comstock, in the shafts, drifts, and winzes which have been opened in those mines in the search for the precious metals. While it is quite impossible to predict with any degree of certainty exactly what kinds of rock will be met with in the progress of the tunnel, or in what proportions, it is safe to assume that nothing will be encountered which will offer any serious obstacle to the miner. We, therefore, dismiss this portion of the investigation with the expression of the opinion of the commission in favor of the entire feasibility of the tunnel project, so far as its construction is concerned.

COST OF THE TUNNEL.

In making the estimate of cost, the commission has been governed mainly by costs of shafts and drifts in the mines on the Comstock, and by the actual expenditures as reported by the tunnel company in running its preliminary tunnel or drift, which, as has been stated, has already penetrated over 2,500 feet under the mountains lying between its mouth and the lode. Taking all these elements of information into consideration, an average of cost per foot of length has been deduced, which, in the judgment of the commission, is as reliable as any that can be arrived at for an estimate for a tunnel which is to run for so great a length through rocks, the character of which can only be judged of, and then only imperfectly, by surface indications. This cost, which is given for the main tunnel and its shafts separately from that of the cross or branch tunnel, is:

For the main tunnel and four shafts.....	\$2,707,595 15
For the branch tunnel and two shafts	1,710,734 35
Total in gold.....	<u>4,418,329 50</u>

This estimate, the details of which are given in the appendix, embraces all the expenditures supposed to be necessary for the completion of the work, including machinery, fuel, shelter, superintendence, &c. It is but proper to remark, however, that its correctness will depend in a large degree upon the character of rock met with, and may be either too large or too small as the difficulties shall be found to exceed or fall short of the supposition upon which the estimate is based. The prices stated are in gold, which is the only basis of value recognized in Nevada.

TIME REQUIRED FOR THE CONSTRUCTION OF THE TUNNEL.

Our estimates are based upon the progress made in the shafts and drifts in the mines of the Comstock lode, and also upon the actual progress in the construction of the preliminary tunnel so far as it has been prosecuted, all of which have been executed by manual labor. Under this supposition of progress it will require 1,186 days, or about three and one-fourth years, for the completion of the main tunnel after the work shall have been fairly commenced at all the shafts; and if the cross or branch tunnel be commenced at the same time, as it may be, and pushed forward correspondingly, the whole may be completed in nearly the same time; that is, in about three and four-tenths years after vigorous operations shall have been undertaken upon all parts. But if machinery be judiciously employed, there seems to be no doubt that the tunnel may be completed in two and three-tenths years. Considerable attention has been given to the subject of the application of machinery to this object, resulting in the conviction that the time needed for the completion of the tunnel, beyond what would be required if manual labor alone were employed, may, by its use, be shortened at least one-third.

THE VALUE OF THE BULLION EXTRACTED FROM THE MINES ON THE COMSTOCK LOPE.

To ascertain with perfect accuracy the total value of the bullion extracted from the mines of this lode is quite impossible, owing to the almost total absence of records during the early days of mining. The

commission has, however, obtained a statement of the bullion sent by express, by which it has been mainly transported, amounting for the ten years from 1861 to 1870, both inclusive, to \$123,607,278; and it is the opinion, of those well informed upon the subject, that the product of the mines previously to 1861, including bullion taken away by private parties, will swell the total production, from 1859 to 1871, to \$125,000,000.

PRESENT AND PROBABLE FUTURE PRODUCTION.

The mines which are now productive are given below, with the amount of bullion for the last year so far as ascertained; all the other mines on the ledge being engaged in prospecting only:

1. Savage.....	\$818,216 50
2. Hale & Norcross.....	1,632,500 03
3. Chollar Potosi.....	3,455,423 08
4. Yellow Jacket.....	2,000,000 00
5. Kentuck.....	Not reported.
6. Crown Point.....	Do.
7. Belcher.....	Do.

The present annual production may, it is believed, be taken with sufficient accuracy at \$15,000,000.

As regards the probable future yield, no claim can be made to anything like accuracy, except in the few instances in which ore-bodies are now developed. The commission has already stated its belief in the lode being what is known as a true fissure vein, or as continuing downward indefinitely in the crust of the earth; but whether the vein will continue to be ore-bearing cannot be predicted with any degree of certainty. It is a matter of opinion, to be based, however, upon probabilities and the actual results experienced in deep mining in other parts of the world. These, in the judgment of the commission, favor the finding of ore down to the lowest depths that can be reached; and that this opinion is shared by most of the mining authorities seems to be shown by their continued downward search.

Some few of the mines, as the Crown Point, Belcher, Hale & Norcross, and Yellow Jacket, have ore enough in sight to occupy them for three or four years to come; others, like the Savage, will exhaust all known bodies in a shorter time, while others still will have to depend for their future upon the success of the prospecting in which they are engaged, or upon the low-grade ores which have been passed over or thrown aside as not paying for the cost of working; this last involving the necessity for a large economy beyond what is now practical in the working of the mines and in the transportation and reduction of the ores.

ON THE "GEOLOGICAL AND PRACTICAL VALUE" OF THE SUTRO TUNNEL "AS AN EXPLORING WORK."

In view of the limitations contained in the law, the commissioners confined their geological investigations to the line of the tunnel and its immediate vicinity.

To the works of Baron Richthofen, who devoted many months to a careful examination of the rock formations of the Washoe district; to Professor Whitney, who determined by barometrical measurements the elevation of the mountains and valleys, and determined the geologic age of the deposits near Dayton; and, finally, to the able report of Mr. Clarence King, recently issued from the Government press, we acknowl-

edge our obligations. With the extended labor of these gentlemen on the general geology of the country, it is not a subject of regret that economic geology, with its special application, forms the limit of our investigation.

The entire region in the vicinity of Virginia City gives the evidence of an extensive dynamical disturbance, continued through a long period of time with more or less activity. Volcanic action to an extent and of an intensity not met with in modern times, has played an important part in the formation of numerous mountain peaks, and in giving to the scenery a broken and rugged aspect, which is heightened by the sterility of the soil. Without a tree or shrub to relieve the eye, excepting the sickly-looking artemesia or sage-brush, struggling for existence, the broken and jagged trachytic rocks impart a character of wilderness to the country, and the name of "Devil's Gate," given to one of the passes, indicates the feeling which prompted the first rude settlers to bestow such a name to the rugged scenery. Passing from Virginia City eastward for a distance of four miles in a right line, we reach the comparatively fertile valley of the Carson, while within the range of vision to the northward the sand clouds may be seen sweeping over the desert region known as the Sink of the Humboldt. We do not design giving a full topographical description of this interesting but sterile country, but desire to convey the idea of the worthlessness of these mountains except for the boundless wealth in minerals which they contain.

The various ages and modes of deposit of the rock formations have an important practical bearing, and require our special attention.

Mount Davidson, from its height and position, as well as from its lithological characters, was the first to make its appearance amid the snow mountain peaks of the Washoe district. It is a sienitic rock, compact in structure, difficult to work, and bears important relations to the Comstock lode, forming the west wall for a considerable distance, if not through its entire extent. The elevation of Mount Davidson has been determined at 7,827 feet, its summit rising 1,622 feet above Virginia City, and has a range of outcroppings of quartz rock skirting its eastern side some 1,500 feet below its summit.

To the eastward on the line of the proposed tunnel are numerous hills, intersected by valleys or deep ravines, extending to the plains of the Carson River.

Next in order to the sienite is an extensively diffused volcanic rock called propylite, which was spread over the entire portion of the tunnel section. This is the green stone or "green-stone trap" of the miners, and works with great facility. It is thickly studded with fine granules and occasionally with distinct crystals of sulphuret of iron. It is important as furnishing the eastern or hanging rock of the Comstock lode.

Through the propylite, at a later period, volcanic craters have been opened, and formed by their ejections hills or mountains of considerable elevation, varying much in their color, compactness, and the circumstances attending their formation. The most common variety of this trachytic rock is a simple greyish, pasty mixture, with its particles loosely cemented together, easily worked with the pick, except at considerable depths, when it becomes compact and is useful as a building-stone. The structure of the rock indicates that the volcanic ashes of which it is composed were ejected in connection with water or steam and cooled rapidly after its deposit. The mud volcanoes of Western Mexico furnish a type of this form of deposit. Another variety of the same color, with numerous crystals of glassy feldspar diffused through its mass, from which it has received the name of sanadin trachite, was deposited

in a similar manner, but cooling slowly gave an opportunity for the play of chemical affinities, by which the crystals were formed, and a more compact structure of the rock resulted.

A third variety, with a color ashy grey, or of a more or less deep red color, is found one and a half miles from the mouth of the tunnel. With the same chemical constituents, except the addition of oxyde of iron, we have in this a firm, hard rock, working with difficulty.

Still another variety of considerable practical importance is met with, which has been passed through for a distance of 750 feet at the commencement of the tunnel, which may be distinguished under the name of trachytic conglomerate. It is characterized by numerous angular masses, sometimes of great size, cemented together by the ash-colored trachytic matter, and offering to the drill and giant powder serious obstacles to rapid progress in the work of constructing the tunnel. This formation is due to the breaking down of the walls of the crater and the projection of their broken up, angular masses into the ashy deposits from the volcano. These walls were, at this place, composed of metamorphic porphyry, the fragments of which are now held together firmly by the cementing material.

Numerous recent instances might be cited for illustrating the action of ancient volcanoes, the same laws which governed in former times being operative at the present, but with far less intensity.

In 1813 a volcanic eruption of ashes occurred on the Island of St. Vincent, which fertilized the Island of Barbadoes, the ashes falling in Bridgetown to a depth of several inches. The amount of material thrown out must have been immense, as the transfer was made in opposition to the trade-winds.

The once beautiful and symmetrical volcano of Consaguina, in Central America, some forty years ago exploded with a report heard at Santa Fé de Bogota, a distance in a right line of one thousand eight hundred miles, and emitted ashes in such quantities that, for hundreds of square miles, the sun was obscured, and for ten days made a midnight darkness over most of Honduras and San Salvador. The ruins of Pompeii and Herculaneum furnish us with well-known examples of similar volcanic eruptions.

The other formations on the line of the tunnel are of much less consequence in this connection. At the St. John's mine, on the Monte Christo lode, is a deposit of granular limestone, which disappears at some 200 feet in depth where the propylite is in place.

Andesite, a hard hornblendic rock, caps one of the hills near the route of the tunnel. This is of volcanic origin, and is only less hard than obsidian, of which a few scattered specimens were met with.

To recapitulate, we have for a basis the syenite of Mount Davidson, then propylite, (with porphyry,) sanidin trachyte, loosely aggregated, and compact trachyte, trachyte conglomerate, andesite, and carbonate of lime on or near the line of the tunnel.

It becomes a matter of much importance to determine the character of the rock excavation in estimating the cost of construction and the time required to complete the tunnel. The quartzite met with in the Hoosac tunnel has greatly impeded the progress of that great work, causing a weary delay, and leading to great expense in construction. With this example before us for not relying upon surface indications alone for the character of the rock excavation, your commissioners sought every indication possible for obtaining a correct idea of the formations through which the Suto Tunnel will be required to penetrate. We were still more strongly impressed with the necessity for using great

precaution in our determinations, as unexpected results had already been obtained in the portion of the tunnel or heading which had been driven some 2,300 feet. The surface indicated that, for this and a much greater distance, the tunnel would pass through trachytic rock only. On the contrary the following results were obtained, viz:

	Feet.
1. Trachytic conglomerate.....	750
2. Trachyte.....	500
3. Trap-dyke.....	40
4. Red clay.....	70
5. Blue clay (<i>porphyritic</i>).....	100
6. Porphyry.....	840

The firmness of the conglomerate will be sufficient to support itself without timbering. All the others will require this support, and the blue clay continually acts upon and crushes the frame-work, requiring constant care and frequent excavations behind the timbers to prevent the complete closure of the adit. This difficulty is encountered in many of the mines, until the clay becomes sufficiently dry to resist the great pressure of the vast body of the same material behind it. No part of the tunnel will cost as much per hundred feet as that passing through this clay.

In an economic view, the porphyry and prophyllite may be considered the same, having about equal density, and working equally well under the drill. In the former, a greater liability exists of encountering clay seams, as a result of the disintegration of the feldspar, which enters largely into its composition.

With but comparatively slight exceptions, these two formations will be the only ones encountered in the construction of the tunnel, for they underlie the trachytic and other volcanic rocks, and, except in chimneys, these later formations will not be encountered.

The prophyllite by exposure to moist air too readily disintegrates in consequence of the changes effected in the sulphuret of iron, with which it is filled, and will require to be timbered in consequence. All the circumstances named have been taken into consideration in forming an estimate of cost, and as an element in determining the time required in construction.

By the cooling of the vast field of prophyllite which had been poured out, we may assume that the contraction was sufficient to cause a vast fissure near or at its junction with the sienite.

The period of active volcanic movement again occurring, there was injected from below a body of quartz in quantity sufficient to fill this fissure. Practically, it does not matter whether this was accomplished by solfataric action or by direct volcanic forces, or whether we consider the metallic wealth deposited in the lode by super-heated steam and the action of acids, or consider that with the siliceous the gold and silver were thrown up by the same force.

We know that for a distance of five miles, with a varying width of from 50 to 500 feet, and to an unexplored depth, the Comstock lode is found one of the richest, most productive and extensive in the records of mining.

It is, however, of very great importance to determine whether the Comstock be a true fissure-vein, as declared by most intelligent geologists, or be but a gash-vein, with its material filled in from adjacent rocks. The permanency of the mining interests of Nevada depends upon which of these views prove correct. In the first contingency we may claim that no true fissure vein has ever been worked out, and from

analogy we may draw the conclusion, with a good degree of certainty, that the Comstock cannot be exhausted by the labor of man. If but a gash-vein, the conditions are so changed that exhaustion must at no distant day be the result. In a careful examination of the rocks near the lode, we do not find a loss of any proportion of the quartz which belongs to them. From whence, then, could this mineral have been derived? Again, the only source of supply by washing in must have been obtained from a higher level, or the syenite of Mount Davidson. This would imply a decomposition of that rock; and the hornblende, one of its constituents, would as readily be carried into the opening as the quartz. The hornblende is not found mingling with the silicious deposit, therefore the latter could not have been received from the syenite.

We are left to the only possible explanation of the occurrence of this wonderful deposit, *i. e.*, that it is a true fissure-vein filled from below, and, like other fissure-veins, extends to a depth beyond the power of man to reach. The explanation of the clay selvages bounding the vein-matter, the formation of "horses" by the falling of portions of the hanging rock, the exhaustion of rich bonanzas or bodies of paying ore, the barren condition of much of the quartz, are none of them peculiar to the Comstock lode, but are met with in other mines of a similar character, and have been fully described elsewhere. The crushed and crumbly condition of much of the vein-matter has been ascribed to dynamical action, supplemented, doubtless, by chemical changes in the sulphurets met with in considerable quantities in the lode. With reference to the future productiveness of the mines, until carefully explored at deep levels, much must be left to conjecture. The mere fact that the Comstock is a true fissure-vein establishes that the vein-matter or quartz extends downward indefinitely, but does not prove that this material is charged with the precious metals. Reasoning from the past history of fissure-veins in other countries, we have just grounds for believing that the metallic wealth, thousands of feet below the surface, will fully equal or be even greater than that from higher levels. The Sampson mine in Germany has reached a depth of 3,000 feet without any diminution of its yield of silver. This, compared with the Comstock, is a small vein, but for that very reason is far more likely to be lost by a fault than one of the magnitude of the lode under consideration.

It is quite probable that at great depths the metals are more equally distributed through the vein matter, in which case the very rich ores will not be met with, but the whole mass will yield an equally favorable result, without the large expenditures required in drifting for bonanzas. The recent discoveries in the Crown Point and Belcher mines of immense bodies of "rich rock" at nearly 1,700 feet below the initial point is a most encouraging feature for the permanent value of the lode.

We had the privilege of examining such portion of the bonanza of the Crown Point as had been uncovered, estimated to be worth \$15,000,000, with a prospect of equal value at a still greater depth. Judging from the present quotations of the Belcher stock, this latter mine should give even greater results than the Crown Point.

One other feature of the recent discovery becomes important to the mine owners and to the country. Upon the upper levels of this and some other mines, if not in all, the yield of gold was greater in value than of silver. As the mining progressed in depth, the silver yield to

the ton of ore became the greater, but in the new discoveries the more precious metal is restored to its previous relative proportion.

An examination of the reports of superintendents give us a much higher per cent. of the gold contained in the ore secured than of silver. In the report of the Savage mine, of this year, we find that the *loss* in working from the assay value of the ores is, of gold, $25\frac{1}{10}$ per cent., of silver, $34\frac{2}{10}$ per cent. The larger the proportion of gold in the ore, the less absolute loss is made in the working.

The above statement is the result of the workings in the Occidental mill, under the direct control of the Savage Company, and includes all savings from slime and tailings secured to the company.

In the Custom's mills, the report shows a less favorable result on the silver product, as follows: Gold loss, $23\frac{1}{10}$ per cent.; silver loss, 44 per cent.

It may not be out of place to remark that the loss on the gold product is ascribed to "float gold," which might possibly be secured by running the surface-water or "float" through sponges. The loss of silver is due to a failure in the works to secure the sulphuret of silver, and, to a limited extent, to particles of clay, carrying with them minute portions of silver, as suggested in the report of Mr. Clarence King.

It is well understood by all who have given their attention to the subject, that the metallic deposits are not equally diffused through the vein-matter, but are found in detached bodies called "bonanzas." This rule holds good in the Comstock lode as well as in all other silver lodes, having quartz as a gangue. An examination of the mining map, exhibiting the workings of this lode in detail, proves the deposition of the rich ores of the precious metals in *bodies*, and the comparatively barren quartz in other portions.

There is no law yet evolved from experience or science for determining the position of these rich bodies of ore; explorations alone can discover their position and value. It is, however, sufficient to know that they are confined to the vein-matter, and their discovery may be expected so long as we confine our workings within the boundaries of the "country rocks."

By the present system of working the ores from these mines, rock that yields by assay less than \$30 to the ton, cannot be reduced at a profit.

The amount of low-grade ores, ranging from \$10 to \$35 in the Comstock lode, amounts, by the testimony of some witnesses, to millions of tons. The following forms a small portion of the evidence obtained upon this subject: Colonel Requa, superintendent of the Chollar Potosi mine, in his various reports, mentions the large amount of ores that at some future time may be made available to the owners, that with present prices for labor and by the present processes of reduction cannot be utilized. He stated, personally, that very large bodies of sixteen-dollar ore exist in the mine.

A former superintendent of the Empire and Imperial mine stated that while in charge he struck a body of ore that yielded \$19 per ton, which, at the then cost of mining, transport, and reduction, did not pay. This body was prospected in the middle of the lode, more than 100 feet wide, to a depth of 6 feet only. How large this body of ore may be he was unable to state.

Mr. George Atwood, at present superintendent of the Eberhart mine, has worked as foreman, &c., for eight years on various mines of the Comstock lode, states that in the south mine of the Ophir a body of ore exists that has been mined and used for filling in stopes for a distance

of 300 by 300 by 100 feet, which will average, by assay, \$20 per ton. A large body in the north mine, yielding but little less, is found in place. He further states that in the Crown Point, on the 200-foot level, an estimated amount of 100,000 tons of ore, that will assay \$20 per ton, may be found. Was for three years connected with that mine, and is thoroughly acquainted with the upper levels.

From our own observation, and the evidence of others, we do not hesitate in stating that vast amounts of what are designated as low-grade ores abound in these mines, that may yet be made available in increasing the national wealth.

At each extremity north and south from the principal mines the workings are carried on exclusively for gold. The Sierra Nevada Company, the most northerly of the group now in operation, is understood to be profitably engaged in working the loose surface rock and soil. At the other extreme the Succor mine and mill, situated on Gold Cañon, are in operation; the vein of precious metal having been followed into the mountain 1,300 feet, and the ore is taken to the mill direct through a tunnel. The facilities for working and the economy exhibited has saved the stockholders from the usual heavy assessments.

A careful survey of the adit of this mine developed an unexpected fact. Following the windings of the tunnel, which kept pace with the sinuosities of the vein of ore, we reached the same character of quartz rock that had become familiar to us in the mines of the Comstock. This was an accidental discovery of the miners during a search for the gold vein, which had been lost from a fault. This "white lode" assayed \$22 60 per ton. By taking the bearings by compass in this and in the Crown Point mine, they indicated a connection with each other. The theory has been that near the Overman mine the vein or lode bent around to American Flat, where it ceased. Further research may be necessary to establish with certainty the view, that a branch at least of the Comstock lode passes down Gold Cañon and shows itself in the Succor mine, one and a half miles below the Crown Point.

The appearances indicate that the "white lode" and the gold vein will at no great distance unite to form a rich lead, and when thus joined the value of the gold and silver lead will be condensed into the gangue of one with the relative proportions of gold to silver now met with in the Crown Point.

The value of the proposed Sutro Tunnel simply as an exploring work is so evident as to be scarcely called in question. Cutting, as it does, at right angles two or more lodes before reaching the Comstock; that, in Europe, would be deemed valuable; the determination of their wealth or poverty would prevent further ruinous outlays in prospecting. There is no certainty that rich bonanzas will be met with in the progress of the work, but that an abundance of moderately rich ores will be found is quite probable. We found at the Occidental mine, on the Monte Christo lode, two adits or tunnels had been run, one to the distance of 1,850 feet for a considerable distance through crystalline limestone, after which porphyry and then propylite made their appearance as we penetrated the tunnel.

The quartz vein is often broken down and crumbly and colored by oxide of iron. In the limestone excavated we noticed arborescent crystals of manganese. Extensive galleries and wide chambers were met with, from which rock working from \$10 to \$33 had been taken. The upper tunnel had been run for 1,500 feet and connected by a shaft to the lower one. We noticed that the current of air passed down the shaft and out at the lower tunnel. Much of the quartz rock is nearly

or quite barren, but we were informed that millions of tons assaying from \$8 to \$10 to the ton existed in the mine. We believe this to be a fair index of the character of the Monte Christo lode which we visited in other localities. What developments will be made at the great depth at which the tunnel will cross its track is, of course, uncertain. The heading which has been run will, if continued a few hundred feet farther, cut the "Great Flowery lode," with what result we are not prepared to predict.

We made an examination of the Lady Bryan mine, said to be located on this lode. The croppings of quartz rock is enormous in quantity, forming a hill about 100 feet high, and would yield for the whole mass, as we were informed by the superintendent, an average of \$8 per ton of silver.

An open cut has been made through the hill or body of quartz rock into a large basin formed by the excavation of material, some of it valuable, but a large quantity too poor for working.

Short drifts have been run into the hill-sides in various directions, which at the time of our visit were not worked. The richer ores were being assorted for milling, the mine furnishing but eight or ten tons per day of valuable material. Only ten men were employed on the works at the time, the mine having recently passed into new hands.

With reference to the tunnel cutting *blind lodes*, we are not prepared to express an opinion, the very name implying a complete want of knowledge of the subject. The possibility barely exists, with the past history of mining giving strong practical evidence against the probability of a favorable result.

As an exploring work, we think the Sutro Tunnel may claim to determine with sufficient certainty the ore-bearing character of the Great Flowery and Monte Christo lodes, and settle definitely the question whether the Comstock lode at great depths continues in richness; or, as is believed by some, becomes worthless as the deep levels are opened. It is somewhat remarkable, as bearing on this subject, that the Crown Point, once justly esteemed valuable, and ranking high in the stock board, became almost worthless under the supposition that the mine was worked out. By the energy and perseverance of the superintendent, the owners were rewarded by the discovery, at deep levels, of one of the richest bonanzas yet found on the Comstock lode, which sent the stock up from \$2 50 per share to over \$300. It must be borne in mind that at two or three points shafts reaching as low as the tunnel will be sunk by the time of its possible completion. This will not be so complete an exposure of the value of the lode as drifts from the lateral tunnel, made at comparatively small expense, at numerous points along its course.

We cannot but think, therefore, that, as an exploring work for deep mining, the Sutro Tunnel may justly claim favorable consideration.

Respectfully submitted.

H. G. WRIGHT,

Lieutenant Colonel of Engineers, Brevet Major General.

J. G. FOSTER,

Lieutenant Colonel Engineers, and Brevet Major General,

United States Army.

WESLEY NEWCOMB,

Civil and Mining Engineer.

Brigadier General A. A. HUMPHREYS,

Chief of Engineers, United States Army, Washington, D. C.

OFFICE SUTRO TUNNEL COMMISSION,
New York, December 2, 1871.

GENERAL: I have the honor to transmit herewith a letter from Mr. Adolph Sutro,* in which he states that he has not been able as yet to prepare the paper which he desired to furnish, relative to the advantages of the tunnel as compared with the present method of working the mines; but he incloses a printed copy of a speech delivered by him at Virginia City, in support of his project, and desires that it may be added to the appendix of the commissioners' report.

This printed speech is also inclosed, and I would ask that it be attached to the appendix of the report, as desired by Mr. Sutro. I would further suggest that his letter be also appended.

Very respectfully, your obedient servant,

H. G. WRIGHT,
*Lieutenant Colonel of Engineers, Brevet Major General,
 Senior Officer of Commission.*

Brigadier General A. A. HUMPHREYS,
Chief of Engineers, United States Army, Washington, D. C.

APPENDICES.

APPENDIX A.

Estimates of cost of the Sutro Tunnel.

Cost of sinking shaft No. 1, 109 square feet area and depth of 530 feet, including tools, labor, and materials of all kinds, at \$40 24 per foot of depth, (being the average cost in the seven principal mines of the Comstock lode).....	\$21,327 20
Same, shaft No. 2, 109 square feet, 1,025 feet deep, at \$40 24.....	41,246 00
Same, shaft No. 3, 109 square feet, 1,319 feet deep, at \$40 24.....	53,076 56
Same, shaft No. 4, 109 square feet, 1,499 feet deep, at \$40 24.....	60,319 76
Same, shaft No. 5, 109 square feet, 1,465 feet deep, at \$40 24.....	58,951 60
Same, shaft No. 6, 109 square feet, 1,465 feet deep, at \$40 24.....	58,951 60

Preliminary tunnels or drifts.

Cost of labor, tools, and materials of all kinds, for drift of main tunnel, 6 feet wide, 7 feet high, and 19,790 feet long, at \$16 90 per running foot, (being the average cost of 2,185 feet completed July 1, 1871).....	\$393,821 00
Deduct value of one-half of timber of drift, which may be used again as the enlargement progresses.....	14,644 60
	379,176 40
Cost of labor, tools, and materials of all kinds, used in drifts of branch tunnel, 6 feet by 7 feet, by 12,000 feet long, at \$19 90 per running foot.....	238,800 00
Deduct value of one-half timber of drifts used a second time.....	8,880 00
	229,920 00
Cost of enlargement of drift to full size of tunnel, 13½ feet by 12 feet, by 19,720 feet long, 2,366,400 cubic feet, at 25 cents.....	591,600 00
Same, of branch tunnel, 12,000 feet long, 1,440,000 cubic feet, at 25 cents.....	360,000 00
Cost of timbering main tunnel full size, 19,720 feet in length, at \$17 34 per running foot.....	341,944 80
Same, of the branch tunnel, 12,000 feet, at \$17 34.....	208,080 00

* See Appendix M.

SUTRO TUNNEL.

Cost of general material and sundries, including surveying instruments, large transit building for the same, boarding and lodging houses, barns, horses, carts, magazines, blowers, air-pipes, &c., for four shafts of main tunnel	\$66,439 00 ,
Same, for branch tunnel, two shafts	20,000 00
Cost of hoisting and pumping engines and machinery for four shafts of main tunnel	121,679 00
Same, for branch tunnel, two shafts	108,930 00
Cost of boilers and parts, four shafts, main tunnel	33,736 40
Cost of boilers and parts, two shafts, branch tunnel	25,256 00
Cost of labor and materials for the erection of machinery, and temporary buildings to cover the same, for the four shafts of main tunnel	32,265 00
Same, for the two shafts of branch tunnel	21,510 00
Cost of material and time employed in attending machinery during the sinking of four shafts, main tunnel	138,734 27
Same, for the two shafts of branch tunnel	82,489 50
Same, during the running of the preliminary tunnel of the main tunnel ..	324,784 90
Same, of branch tunnel	216,523 26
Cost of appliances for hauling rock and ore out of main tunnel	50,000 00
Cost of appliances for hauling rock and ore out of branch tunnel	35,000 00
Add for office expenses, superintendence, engineering, and contingencies, 20 per cent.	736,388 25
Total cost in gold	<u>4,418,329 50</u>

RECAPITULATION.

	Main tunnel.	Branch tunnel.
Sinking shafts	\$175,969 52	\$117,903 20
Running preliminary tunnels	379,176 40	229,920 00
Enlargement of drifts to size of tunnel	591,600 00	360,000 00
Timbering full-size tunnel	341,944 80	208,080 00
General materials and sundries	66,439 00	20,000 00
Engines and machinery	121,679 00	108,930 00
Boilers and attachments	33,736 40	25,256 00
Erection of machinery and temporary buildings for same ..	32,265 00	21,510 00
Attending machinery in sinking shafts	138,734 27	82,489 50
Ditto in running preliminary tunnels	324,784 90	216,523 26
Endless wire-rope, &c	50,000 00	35,000 00
	<u>2,256,329 29</u>	<u>1,425,611 96</u>
Office expenses, superintendence, engineering, contingencies, 20 per cent	451,265 86	285,122 39
	<u>2,707,595 15</u>	<u>1,710,734 35</u>

Time required to complete tunnel.

Depth of shaft No. 4, (the deepest)	1,499 feet.
Average daily progress in the shafts of the Comstock	3 feet.
Number of days required to sink shaft No. 4 1,499 feet	500 days.
Whole length of main tunnel	19,790 feet.
Distance penetrated by preliminary tunnel, July 1, 1871	2,185 feet.
Average daily progress in preliminary tunnel	4 $\frac{15}{100}$ feet.
Distance penetrated when shaft No. 4 reaches tunnel level	4,260 feet.
Distance remaining to be penetrated at that time	15,530 feet.
Number of available working headings	9
Greatest distance to be penetrated by any drift to meet the drift from the adjacent shaft	2,432 feet.
Time required to run above distance at 4.15 per day	586 days.
Total time required to sink shafts and run drifts	1,086 days.
Additional time required to enlarge tunnel to full size	100 days.
Total time required to complete main tunnel	1,186 days.
Number of years required to complete main tunnel	3 $\frac{1}{4}$ years.
Number of feet of branch tunnel run from four headings at bottom of shafts Nos. 5 and 6, 1,465 feet deep, when main tunnel is completed ...	414 feet.
Additional time required to extend branch tunnel to 12,000 feet working two headings	50 days.
Total time to complete main and branch tunnels, (manual labor)	3 $\frac{7}{10}$ years.
Total time to complete main and branch tunnels, (by machinery)	2 $\frac{3}{10}$ years.

APPENDIX B.

*Circular to superintendent of mines.*OFFICE SUTRO TUNNEL COMMISSION,
Virginia City, Nevada, July —, 1871.

SIR: By the act of Congress approved April 4, 1871, this commission is required to report, among others, upon the following points, viz:

1. The value of the bullion extracted from the mines on the Comstock lode.
2. Their present and probable future production.
3. The geological and practical value of said tunnel as an exploring work.

Much of the information required by the above can be obtained only from the companies engaged in mining on the Comstock lode; and as regards the rest, the information which the companies can afford will be of the highest value to the commission in the discharge of its duties. I am, therefore, instructed to request of you your views in writing, upon the points above quoted, as well as upon any others which you may deem to have a bearing upon the question of the construction of the Sutro Tunnel. I also take the liberty, under the instructions of the commission, to append a series of questions having a bearing upon the portions of our duties not enumerated above, your answers to which will be important in making up our estimates of the probable cost of the proposed tunnel, and its value as an aid to deep mining on the Comstock lode.

Should your reply to the foregoing not be ready before the commission leave Virginia City, please forward it addressed to me at the Army Building, New York City. The earliest practicable answer will, however, oblige.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Brevet Major General, Senior Officer of Commission.

To ————,
Superintendent of ——— Mine.

The following are the questions to which answers are asked:

1. Cost at various depths of sinking shafts, estimated by cubic foot removed, or by the running foot for a shaft of given dimensions.
2. The present cost of timbering the same, with increase, if any, with the depth.
3. The cost of drifting in the various rocks met with in your operations; estimated either by the cubic foot or by the running foot, specifying the dimensions of the cross-section.
4. The cost of timbering the same.
5. The daily progress made in the shafts and drifts through the various rocks, the largest force that can be worked to advantage being employed.
6. The cost of ore, water, &c., from various depths.
7. The cost of pumping at your mine for twelve months; preferably for the year ending June 30, 1871.
8. Has the water in your mine increased or diminished with the depth, and in what proportion?
9. The cost per ton of ore for milling; and where the cost of transportation to the mill is included, the cost of the latter.
10. What is the present cost of the artificial ventilation of your mine, and how does it increase with the depth?
11. How long a time at the present progress of working will it require to exhaust all the profitable ore in the mine, above the 600-foot level?
12. How long between the 600 and 1,000-foot levels?
13. At what depth will the present machinery be available for hoisting the ore or clearing the mine from water?
14. What additional expense will be incurred, if any, per 1,000 feet of additional depth for the purposes above named, calculating from the 1,000-foot level?
15. What is the width of the lode and also of productive vein-matter at the various levels of your mine?
16. What has been the expense of prospecting the mine for the year passed?
17. How does the pay-ore compare at each level, from the surface downward?

APPENDIX C.

OPHIR.

OFFICE OPHIR SILVER MINING COMPANY,
Virginia City, Nevada, September 21, 1871.

SIR: In compliance with your communication of July 28, asking my views upon the question of the construction of the Sutro Tunnel, I beg leave to respectfully submit the following:

Answer to congressional question No. 1, the value of the bullion extracted from the mines on the Comstock lode.—Bullion extracted from the Ophir mine since the incorporation of the company, in July, 1860, \$4,631,539 10.

Nos. 2 and 3. Their present and probable future production, and the geological and practical value of said tunnel as an exploring work.

In answer to congressional question No. 3, I will briefly state, as to its geological value, I am not competent to judge; but as to the practical value I will offer a few remarks: First, I will consider its value as an avenue through which all the mines on the Comstock may be worked, as it is claimed by Mr. Sutro that all the machinery on the lode may be dispensed with both for hoisting and pumping, and the entire business of or work of all the mines be carried on through his tunnel. You will please consider the tunnel with all its lateral drifts completed, and all the mines on the Comstock being worked through it. No machinery is used on the surface.

We have, to begin with, (page 19, "Sutro Tunnel,") 3,000 miners to carry to and from their work, an average distance from the mouth of the tunnel of four and a half miles. These 3,000 miners divided into three shifts of eight hours each, gives us 1,000 men on each watch. Allowing ten men to a car, it would require one hundred cars to convey the men into the tunnel. The train would occupy 1,200 or 1,500 feet in length of the tunnel, and when the head of this train would reach the place of destination the rear cars would be quite an inconvenient distance back from the place of destination, thereby creating much confusion and more or less delay. It is at this point that the miners' greatest trouble begins, their respective stopes and places of work being far above them. They commence to climb the ladders, and go up various heights, many from 500 to 1,000 feet. They arrive at the place where their day's work is to be done in an exhausted condition, positively unfit and unable to do a day's work.

The timbers used in the various mines are to be conveyed to their respective destinations by the same tedious, slow, and expensive routes—expensive, because time in this country is money in fact, the most expensive commodity that is employed in the working of these mines.

Suppose a cave is threatened in some one of the most distant or inaccessible mines. A car-load or two of timbers immediately and judiciously used, might, and often does, prevent a disastrous cave. By the present mode of working, in such a contingency as the above, the miner would send his order up, and in a very few minutes the return cage would bring the desired timbers, and in a few minutes more the timbers would be in place, and the threatened disaster averted. How would it be in working through the tunnel? The miner would first give his order for timbers, the order conveyed down the ladder, probably 1,000 feet to reach the tunnel, then out of the tunnel, a distance of four or five miles, to the carpenters' shops at the mouth of the tunnel; the timbers procured and sent by return cars to the foot of the upraise, then raised, by some as yet unexplained process, to the point of danger or trouble.

In this way, hours might elapse before the much-needed timbers would arrive, and then they would probably arrive too late to prevent great damage.

Another disadvantage in working the mines through the Sutro Tunnel is, the mouth of the tunnel being located several miles farther from the timber and lumber supplies, would necessarily increase the cost of the same two or three dollars per thousand more than when delivered at Virginia or Gold Hill.

The foregoing are some of the practical objections to using said tunnel as an avenue through which to work the mines on the Comstock, and as a practical miner of more than forty years' experience in various kinds of mining, I make this assertion, that should the tunnel, with all its lateral drifts, be offered *free of charge*, not one mine on the Comstock would be worked through it. And why? Because the present mode of working is cheaper and more expeditious.

Now I will offer a few remarks regarding the various charges imposed upon the mining companies for the privilege of working through this tunnel. Mr. Sutro (page 166 of his book) estimates the daily yield of all the mines on the Comstock at 1,500 tons. For the right to transport this ore through the tunnel, the mining companies must pay 25 cents per ton per mile, or about an average of \$1 12½ per ton, amounting to \$1,687 50 per day, or \$615,937 50 per annum. There should be added to this a like amount for debris or waste, which, including that from all the shafts, winzes, upraise, and drifts purely of a prospecting character, would be more likely to overrun than fall

below this amount, which gives us \$2 25 per ton, or \$3,375 per day, or the large sum per annum of \$1,231,875.

In addition to this, we have the transportation of the miners, which, as he estimates 3,000 men to raise 1,500 tons of ore, gives us two men for each and every ton of ore, equal to \$1 per ton, or a total thus far of \$3 25 per ton, or \$4,875 per day, or the nice sum per annum of \$1,779,375.

As large as this sum is, we must again add to it the cost of conveying the timbers to the respective mines, which is 25 cents per ton per mile, (40 cubic feet or 480 feet board-measure being reckoned as one ton,) and he estimates the total consumption of timber per annum (page 18) to be 16,000,000 feet, which gives us 33,333 $\frac{1}{3}$ tons; taken at an average transportation distance of four and a half miles, amounts to \$1 12 $\frac{1}{2}$ per ton, or a total for this item of \$37,500; or 6.8 cents per ton of ore, added to the above, amounts to \$1,816,875. And yet we are not quite through, for we still have to add the indefinite amount of 50 cents per head for all superintendents, foremen, their assistants, attaches, and visitors that go in and out of this famous tunnel. Taking Mr. Sutro's estimate, we now have taxes in specified items amounting to \$3 31.8 per ton, and for what? For the privilege of working the mines in a more expensive and less convenient way than the present mode of working them. But thus far there is one redeeming feature in the contract. It is this: it is optional with the different mining companies whether they pay any or all of the before-mentioned tariffs, for if they do not work through the tunnel they need not pay any of them.

We now come to a tax that is more arbitrary in its character. No mine on the Comstock lode can escape its provisions. It is what is termed the two dollars per ton royalty, which is intended to be a compensation for draining the mines, and is claimed to be a cheaper mode of drainage than that of pumping, the mode now in use. I will now proceed to the consideration of that branch of the Sutro Tunnel question practically considered. These mines have been worked for about twelve years, more or less, extensively.

It is little more than ten years since I first took charge of a mine on the Comstock. For about three-quarters of that time I have been in charge of mines here, having been absent from this locality about two and a half years of the last ten; hence I speak on this question from experience.

The mine that I am now in charge of, and have been for more than three years past, (the Ophir,) has been, and is still, celebrated as being much the wettest mine on the Comstock, and yet we have no difficulty in overcoming all troubles of an aqueous nature, neither do we anticipate anything in the future of that character that will give us serious trouble.

After these general remarks I will proceed with a few estimates. Mr. Sutro (on page 17) gives us an estimate of what it will cost to pump in all the mines on the Comstock when a depth of 1,550 feet is attained. After very elaborate figuring, he gives us the astonishing sum of \$5,911,560 per annum. That depth is very nearly reached at this time in all the prominent mines, and a comparison can now very justly be made between the estimates made by Mr. Sutro and the actual cost, which, taking the Ophir as a guide, for the year ending May 31, 1871, will not exceed the sum of \$150,000 for all the mines, showing the estimate of Mr. Sutro to be very wild, and renders calculations based upon that estimate unreliable in the extreme.

What is the cheapest and most economical mode of freeing the mines on the Comstock from water—the present plan of pumping, or by means of the proposed Sutro Tunnel under the existing franchise? I state that the present cost of pumping will not exceed \$150,000 per annum.

Taking the estimate of Mr. Sutro as correct, that the daily yield of the mine is 1,500 tons, or 547,500 tons per annum, the two dollars per ton royalty give a sum per annum of \$1,095,000, the cost of drainage through the tunnel.

Comment on these two propositions I hold to be superfluous. There are two principal causes or reasons operating to reduce the cost of pumping on the Comstock in the future as compared with the past; and these are, first, the great reduction in the cost of fuel, (and that reduction is bound to continue until it reaches a price about half the present cost;) and, secondly, the positive decrease in the quantity of water as greater depth is attained; for I hold that there is no more certain event of the future than that the water will decrease in the Comstock as the mines grow deeper, the opinions of Mr. Sutro, Professor Richthofen, or any other scientific gentlemen, to the contrary notwithstanding, and the idea of running a tunnel four miles or more in length, at an outlay of millions of dollars, to tap what is almost certain to be very nearly a dry fissure, seems to me to partake of the absurd in the extreme. This is a dry country, and all who have looked upon it know it.

As a ventilator, this tunnel, if finished, would amount to just what a connection between any two or more mines would—no more and no less. Neither one could possibly be made to ventilate any exploring or prospecting work for which some mode of artificial ventilation, either by patent blower, air-pumps, or some other more efficient method, is necessary.

But the most important question of all in this connection presents itself, and, as yet, is unanswered—does ore in paying quantities exist in the Comstock at these great depths? Taking a practical and the most hopeful view of this question that the facts thus far developed will warrant, I am compelled to say there are grave doubts, notwithstanding Professor Richthofen comes to the rescue and assures us that by his scientific and theoretical vision he sees it, and there is no doubt but ore in paying quantities exists in the Comstock fissure from the surface to untold depths. But gentlemen of his class have deceived us so often that, I am sorry to say, we miners have little faith in their scientific prognostications.

I will now proceed to consider the following questions propounded by the commission, so far as they apply to the workings of the Ophir mine:

1. Cost at various depths of sinking shafts, estimated by the cubic foot removed, or by the running foot for a shaft of given dimensions.

Actual cost of sinking main shaft from 270 feet to 1,002 feet=282 feet.

Time, 3 months—June, July, and August, 1871. Dimensions of shaft, outside of timbers, 18 feet 8 inches by 7 feet 4 inches.

	Total cost.	Cost per foot.
Labor:		
Miners..... \$10,092 00		
Carmen..... 959 00		
Blacksmiths and helpers..... 1,242 00		
Engineers and firemen..... 1,300 00		
Wood-hauling..... 185 00		
	\$13,778 00	\$48 85 $\frac{8}{10}$
Powder:		
647 $\frac{1}{2}$ pounds giant powder..... \$760 81		
500 pounds Hercules powder..... 310 00		
Fuse and caps..... 51 00		
	1,121 81	3 97 $\frac{8}{10}$
Steel:		
757 pounds, at 20 cents..... 151 40		53 $\frac{68}{100}$
Candles:		
1,300 pounds..... 244 65		86 $\frac{75}{100}$
Wood:		
276 $\frac{1}{2}$ cords, at \$10..... 2,765 00		9 80 $\frac{5}{10}$
Total amounts	18,060 86	64 04 $\frac{5}{10}$
Cost per cubic foot	46 $\frac{79}{100}$	

2. The present cost of timbering the same, with the increase, if any, with the depth

Actual cost of timbering main shaft.

47 sets timbers, 6 feet each = 282 feet.

	Total cost.	Cost per foot.
Timbers in set:		
1,912 feet by 47 sets=89,864 feet, at \$22 per M.....	\$1,977 00	\$7 01
Labor:		
1 carpenter and 1 timberman, at \$5 each per day.....	920 00	3 26
Total amounts	2,897 00	10 27

No increase for greater depth.

Total cost of sinking and timbering main shaft 282 feet.

	Total cost.	Cost per foot.
Cost of sinking.....	\$18,060 86	\$64 04 $\frac{5}{10}$
Cost of timbering	2,897 00	10 27
Total amounts	20,957 86	74 31 $\frac{5}{10}$

3. The cost of drifting in the various rocks met with in your operations, estimated either by the cubic foot, or by the running foot, specifying the dimensions of the cross-section.

Cost of running drift from 700-foot level, 866 feet.

Blasting ground. No timbers required. Size of drift, 4 feet 6 inches wide by 6 feet 6 inches high. Time, 8 months; February 15 to October 15, 1869. Six-hour watches—three men on each watch.

	Cost.	Per foot.
Labor:		
Miners.....	\$16,596 00	
Blacksmiths.....	1,452 00	
	\$18,048 00	\$20 84
Blasting material.....	3,099 72	3 57 $\frac{8}{10}$
Steel and tools	132 72	15 $\frac{3}{10}$
Candles	467 00	53 $\frac{9}{10}$
Total amounts	21,747 44	25 11
Cost per cubic foot	86 $\frac{5}{100}$	

4. The cost of timbering the same.—No timbers used.

5. The daily progress made in the shafts and drifts through the various rocks, the largest force that can be worked to advantage being employed.

In main shaft, described in answer to question No. 1, six-hour watches are worked, with six men on each watch. Average daily progress, 3.06 feet.

In running drift described in answer to No. 3, six-hour watches, with three men per watch, were employed. Average daily progress, 3.578 feet.

6. The cost of raising ore, water, &c., from various depths.

Estimate of cost of raising ore from a depth of 1,750 feet, (level of the Sutro Tunnel,) with the machinery now in use. Size of cylinder of hoisting engine, 18 inches by 27 inches.

This estimate is based upon the following proposition: That two reel-shafts be coupled into one, running one cage up and one down at the same time; machinery being geared so that speed of the cage in the shaft is 800 feet per minute; double-deck cages being used, hoisting two cars at a time, each car containing 1,500 pounds of ore. Estimated to make six trips per hour, inclusive of all necessary stoppages or delays occasioned by lowering and hoisting men, and lowering timbers into the mine, and all necessary delays for repairs:

Engineers' wages, per day.....	\$10 25
Foremen's wages, per day.....	4 00
Wood-haulers' wages, per day.....	2 50
Three cords wood per day.....	30 00
Tar for ropes and oil for machinery, per day.....	2 00
Scaling boilers, per day.....	1 00
Wear and tear of machinery, per day	5 00
Interest on cost of machinery, \$28,000, at 1 per cent. per month.....	9 20
Total amount	63 95

Total cost per day for hoisting 216 tons of ore 1,750 feet, \$63 95, or, 29.6 cents per ton.

7. The cost of pumping at your mine for twelve months, preferably for the year ending June 30, 1871.

Actual cost of pumping 700 feet, for the year ending May 31, 1871.

Labor:		
Pitman's wages	\$2,007 50	
Engineers and firemen	5,309 50	
Wood hauler	703 00	
		\$8,020 00
Fuel:		
1,387 cords of wood, at \$12.....	16,644 00	
27½ tons of coal, at \$20.....	555 00	
		17,199 00
Oil and tallow:		
Lard and other oils.....	215 67	
1,315 pounds of tallow	162 37	
		378 04
Interest on cost of pumping-machinery, \$31,000, at 1 per cent. per month.....		3,720 00
Total cost		29,317 04
Value of water raised.....		8,975 00
Net cost of raising water		20,342 04

Amount of water raised during the year ending May 31, 1871.

Monthly average of daily measurements:

1870.		
June.	18 inches.	Present flow of water September 10, 1871, 5 inches.
July.	16 inches.	
August.	11 inches.	Decrease in amount of water at 700-foot level, from June, 1870, to date, 72.23 per cent.
September.	11 inches.	
October.	10 inches.	
November.	10 inches.	
December.	10 inches.	
1871.		
January.	9 inches.	
February.	9 inches.	
March.	9 inches.	
April.	8 inches.	
May.	7 inches.	

The above measurement is what is termed on this coast "Miner's measurement," the water running under a six-inch pressure.

13. At what depth will the present machinery be available for hoisting the ore or clearing the mine from water?—Hoisting machinery, 2,500 feet; pumping machinery, 1,500 feet.

16. What has been the expense of prospecting the mine for the year passed?—Total mine expense for the year ending August 31, 1871, \$140,571 87. All work being of a prospecting nature.

Should any of the foregoing answers require explanation, I shall be pleased to furnish the same at your request.

Very respectfully, your obedient servant,

H. H. DAY,
Superintendent Ophir Silver Mining Company.

H. G. WRIGHT,
*Brevet Major General and Senior
Officer Sutro Tunnel Commission.*

APPENDIX D.

GOULD & CURRY.

SUPERINTENDENT'S OFFICE, GOULD &
CURRY SILVER MINING COMPANY,
Virginia, Nevada, September 2, 1871.

GENERAL:—In accordance with your request, I herewith inclose answer to your interrogatories of 28th of July.

Yours, respectfully,

C. C. BATTERMAN,
Superintendent Gould & Curry Silver Mining Company.

H. G. WRIGHT,
Major General, Senior Officer Sutro Commission.

No. 1. The value of the bullion extracted from the Comstock lode?

Answer. The value of the bullion extracted from the Gould & Curry mine up to and including June 30, 1871, is \$15,555,232 24.

No. 2. The present and probable future production?

Answer. Present production nothing—the future, dependent upon the success of the explorations now in progress.

No. 3. The geological and practical value of said tunnel as an exploring work?

Answer. Geologically, it would, no doubt, be of value to the scientist. To the Tunnel Company it would be of great value as determining the existence or otherwise of ore deposits within the bounds of its land grant, and to the eastward of the explorations made by the mining companies at work upon the Comstock lode. To the Comstock it would be of no practical value. The advantages of ventilation supposed to accrue from the construction of the tunnel are more imaginary than practical. The current of air supposed to be created by the connection of the tunnel with the working drifts of the various mines will, no doubt, be confined to the main drifts and shafts, while the stopes—which are the working points in all mines—will have to be furnished with air then as now, by artificial means, which can be done by air-engines much more cheaply through the present shafts than through the proposed adit.

The economy claimed over the present method in bringing the ore to the surface is entirely imaginary; that I assert this advisedly, allow me to call your attention to the table in answer to supplemental question No. 6—to the accuracy of which I am willing to certify. The cost of “chuteing” the rock from any point in this mine, say 500 feet above the level of the proposed tunnel, would be greater than to raise the rock to the surface from that depth through the shaft where it would be in dump ready for transportation, while after delivery by “chute” to tunnel level there would still remain four miles of transportation to reach the surface at the mouth of the tunnel, where the ore would be at a greater distance from the reduction works than when in the dump at the top of the shaft.

In this connection, allow me to call your attention to the fact that there is a considerable quantity of low-grade ore remaining in this mine that cannot be worked now with profit, but which, at a lower cost for reduction and material, can be extracted with a moderate profit to the mine; but if to this is to be attached a royalty, I fear the day is still far distant when it shall be made available.

The average value of the ore extracted from this mine in 1868—and which was selected from the reserve just mentioned—was \$18 14 per ton, at a cost of \$16 35 per ton for extraction and reduction; if to this cost had attached the proposed royalty, the result would have been a loss to the company. Some of the other mines on the Comstock have a greater quantity of this class of ore than the Gould & Curry, and as an illustration of the meager margin of profit I beg leave to call your attention to the report of operations in the Savage mine for the year ending June 30, 1871, when the average profit for the year in ore extracted was 42 cents per ton, the gross yield being \$21 43 per ton.

The tunnel, if of any value at all to the Comstock, would be as a drain-tunnel, though even this proposition is a matter of doubt, the explorations on the lode all going to show a decrease of water with increase of depth attained.

From careful estimates, I am satisfied that in this mine 6,500 gallons of water per hour can be raised from a depth of 2,000 feet at a cost of \$84 per day; from this should be deducted the value of the water, which, at present rates, would be about \$1,000 per month, leaving the cost of pumping \$1,500 per month of thirty days; this on the amount of ore produced last year, 24,305 tons, would amount to 75 cents per ton; add to this the cost of raising rock from same depth, 71 cents per ton, and we have a total cost for rock and water of \$1 46 per ton, or 27 per cent. less than the proposed royalty.

If the yield of ore should be equal to the capacity of the machinery at a depth of 2,000 feet, 194 tons per day, the cost of pumping water and raising ore would be \$1 02 per ton, or 50 per cent. less than the proposed royalty, and only equaling the proposed toll of 25 cents per ton per mile.

Supplemental questions.

No. 1. Cost, at various depths, of sinking shafts, estimated by the cubic foot removed, or by the running foot, for a shaft of given dimensions.

Answer. Size of shaft, 13 feet 2 inches by 8 feet 10 inches.

Cost of labor for running foot	\$48 86
Cost of keeping tools in repair	1 97
Cost of powder, fuse, &c.	7 36
Total	<u>58 19</u>

The above is the actual cost of sinking 109 feet in this mine, commencing 1,191 feet from the surface and terminating at 1,300 feet. The rocks passed through were quartz and porphyry, the former predominating unusually hard, consequently the progress was very slow and the work exceptionally costly.

No. 2. The present cost of timbering same, with the increase, if any, with the depth.

Answer. Size of timber used, 12½ by 14 inches; lagging, 3-inch plank.

Cost of timber, &c., per foot in depth	\$8 84
Cost of labor framing	2 00
Total cost per foot in depth	<u>\$10 84</u>

The cost of labor in placing the timbers in position is included in the cost of labor for sinking. No material increase of cost with increase of depth.

No. 3. The cost of drifting in the various rocks met with in your operations, estimated either by the cubic foot or by the running foot, specifying the dimensions of the cross-section.

Answer. The following is the actual average cost per running foot of two drifts run in this mine during the year 1870. I have selected these two for the reason that they were of the greatest length, and the work was prosecuted uninterruptedly, affording a fair average as to progress and cost.

Eldorado Potosi drift, 101 feet below the surface, 480 feet in length, running obliquely across the stratification, 44 feet hard-blasting porphyry, 30 feet clay, 80 feet of quartz, 326 of porphyry, that was worked with pick. Size of drift outside of timbers, 8 feet high, 5 feet 9 inches wide at top, 6 feet 10 inches at bottom inside of timbers; 6 feet 3 inches, 3 feet 6 inches, and 4 feet 8 inches. The cost of placing timbers in position included in cost of running drift.

	Per foot.
Average cost of 44 feet	\$8 00
Average cost of 436 feet	5 00

Seventh-station drift, 1,167 feet below surface, 600 feet in length, running obliquely through heavy clay and hard porphyry. Size outside of timbers, 8 feet 10 inches in height, 3 feet 9 inches wide at top, 6 feet 9 inches in center, 5 feet 10 inches at bottom. Inside size, 6 feet 4 inches, 2 feet, 3 feet 10, and 3 feet 6 inches. Average cost per running foot, including placing of timbers, \$8 10. In this drift the clay, by swelling, was continually displacing the timbers, which had to be eased by cutting away behind them; in many instances we were compelled to use jack-screws to force them back to position, which makes the average cost of this drift more than it would otherwise have been.

No. 4. The cost of timbering the same.

Answer. The Potosi drift, timbered in square-tunnel sets, size of timber 8 by 10 inches, and 3 by 6 inch lagging; sets placed 5 feet apart; cost per running foot, including framing, \$1 89.

Seventh-station drift, size of timber used 14 by 14 inches, framed in arch plank lagging; sets placed 5 feet apart; cost per running foot, including framing, \$4 90. The cost per running foot, timbered in square sets, would have been \$4 76.

No. 5. The daily progress made in the shafts and drifts through the various rocks, the largest force that can be worked to advantage being employed.

Answer. In sinking shaft from seventh to eighth station, that is, from 1,167 to 1,300 feet, the excavation has been entirely within quartz and porphyry, the former predominating and exceedingly hard, as is evidenced by the quantity of powder used. The average progress was 18 inches in depth per twenty-four hours. Twenty men employed; four shifts of five men six hours each. In such rock as was generally found above the 1,167 level the same force would have made about 3 feet each twenty-four hours. In Potosi drift the formation being hard porphyry, soft porphyry, clay, and quartz of average hardness, the drift running obliquely across the formation, the average progress was, through the former, hard porphyry, 4 feet per day, twenty-four hours. Eight men employed; four shifts of two men six hours each. In seventh-station drift, 600

feet in length, formation heavy clay and hard porphyry drift crossing the strata obliquely; the average progress was 3 feet in twenty-four hours. Six men; three shifts of eight hours.

No. 6. The cost of raising ore, water, &c., from various depths.

Answer:

Depth from surface.	Capacity of machinery per 24 hours.	Cost of fuel per ton.	Cost of labor, repairs, and all other expenses.	Total cost per ton.
<i>Feet.</i>	<i>Tons.</i>	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>
400	1,000	07.08	05.84	12.92
800	750	12.09	09.5	22.4
1,300	408	23.1	18.9	42.
1,400	367	25.41	19.87	45.28
1,500	330	27.95	20.84	48.79
1,600	297	30.74	21.81	52.55
1,700	267	33.81	22.78	56.59
1,800	240	37.19	23.75	60.94
1,900	215	40.90	24.72	65.62
2,000	194	44.99	25.69	70.68

The engines work independently, that is, each engine hoists and lowers separately. If the engines were geared together, so that when one cage was being hoisted the other was lowered, the cost per ton would be considerably reduced.

In the above table of cost is included wood, water, \$300 per month, oil, engineers, firemen, boiler-cleaner, woodman, and average cost of keeping machinery in repair.

The cost of raising the water in this mine from a depth of 825 feet, also running pump while sinking to 1,300-feet station has been \$60 per day, the quantity of water raised about 3,500 gallons per hour.

The capacity of the pumps is 6,500 gallons per hour. I estimate the cost of pumping from a depth of 2,000 feet, working pump to full capacity, at \$83 60 per day. This estimate includes wood, engineers, fireman, pitman, &c. From this estimate of cost should be deducted the value of the water.

No. 7. The cost of pumping at your mine for twelve months, preferably for the year ending June 30, 1871.

Answer:

Cost for the year	\$16,425 00
Deduct water sold	6,000 00
	<hr/>
	10,425 00
	<hr/>

No. 8. Has the water in your mine increased or diminished with the depth, and in what proportion?

Answer. The greatest quantity of water in this mine was found above the sixth level from the surface to a depth of 825 feet; from this point downward the quantity of water is very small.

At the eighth station 1,300 feet from the surface the lode is practically dry; were it not for the seepage from above, which finds its way down the shaft, working at this depth could be prosecuted without the aid of pumps.

I beg to call your attention to the fact that in this mine no considerable bodies of water have been encountered except when the country to the west of the lode has been penetrated.

No. 9. The cost per ton of ore for milling, and when the cost of the transportation to the mill is included the cost of the latter.

Answer. The ore from this mine has been delivered to the mills at the dump. The price paid for milling, which included transportation, was \$12 per ton.

No. 10. What is the present cost of the artificial ventilation of your mine, and how does it increase with the depth.

Answer. The cost of ventilation by Root's blower, carrying the air down the shaft through wooden tubing and distributing it through the drifts by galvanized pipe, is \$9 35 per day, furnishing air to all the drifts from 625 feet below the surface to 1,300 feet. No increase of cost with increase depth, except the cost of continuing tubing down the shaft.

No. 11. How long a time, at the present progress of working, will it require to exhaust all the profitable ore in the mine above the 600-foot level?

S. Ex. 15—3

Answer. There is no known body of ore existing above the 600-foot level that could be profitably worked at the present cost of reduction, &c.

No. 12. How long between the 600 and 1,000 foot level?

Answer. No paying ore has ever been found in this mine below 600 feet.

No. 13. At what depth will the present machinery be available for hoisting the ore, or clearing the mine from water?

Answer. Two thousand feet.

No. 14. See answers to Nos. 6 and 7.

No. 15. What is the width of the lode, and also of productive vein-matter, at the various levels of your mine?

Answer. The width of the lode is undetermined. The productive portion of the lode had an average width, from near the surface to a depth of 525 feet, from four of 40 feet; below this depth ore has not been found in paying quantity.

No. 16. What has been the expense of prospecting the mine for the year past?

Answer. For the year ending June 30, 1871, \$193,670 92.

No. 17. How does the pay-ore compare at each level, from the surface downward?

Answer. That taken from near the surface was the most valuable.

All the measurements of depth given in these answers are from top of shaft, except that to No. 15, which is from station A, King map. To make measurements correspond with those used in the Sutro map, 200 feet should be added, that being the difference in level between shaft and station A; thus, our eighth station, which I designated as 1,300 feet, would be 1,500 feet on Sutro survey.

C. C. BATTERMAN,

Superintendent Gould & Curry Silver-Mining Company.

VIRGINIA, NEVADA, September 2, 1871.

APPENDIX E.

SUPERINTENDENT'S OFFICE, SAVAGE MINING COMPANY,

Virginia City, Nevada, September 16, 1871.

DEAR SIR: The value of the bullion extracted from the Savage mine during the year ending June 30, 1871, was \$818,216 50. From the want of the necessary data I am unable, at the present time, to state the value of all the bullion extracted from the mines on the Comstock lode from the time they were first opened, or during the past year.

Not a small portion of last year's production in bullion came from the tailings which had accumulated at mills in former years, and from the remnants of ore bodies left from the old workings in the upper levels of the mine.

From a general view of the present condition and prospects of the mines on the Comstock lode taken together, I do not anticipate any material change for the next year or two from the last year in the amount of bullion which will be produced. Any increase must depend entirely upon developments which cannot now be foreseen.

The practical value of the Sutro Tunnel as an exploring work can only be a matter of conjecture. In the ground which it traverses it may or may not develop important veins of ore. In this respect it stands on even footing with the numerous similar enterprises on a smaller scale which have been carried on in California and in this State. In a geological point of view the discoveries on the route of the tunnel may give much interesting and valuable information. But I am unable to see what practical good any geological development made outside can be to mining within the limits of the Comstock lode. The attempts made by experts in former years to apply the rules and principles of geology in determining the extent, boundaries, and value of the vein were found entirely futile. With practical miners the pick and shovel have come to be recognized as the only reliable experts within the limits of the Comstock lode. In regard to the value of the Sutro Tunnel as an aid to deep mining on the Comstock lode, my own individual opinion has been formed from a few simple facts, and not from any desire to establish any particular theory which has to be supported by an army of figures and statistics. The chief purposes urged, as I understand, for carrying on this work are drainage, the cheaper extraction, and the cheaper reduction of ore. Until experience proved the contrary, it was a prevalent supposition, even among our leading mining men, that, by tapping the lead at one point, the whole vein would at once be drained down to the level of that point. This idea is exploded. The vein matter of the Comstock is intersected in various directions, longitudinally, crosswise, and diagonally, with clay seams impenetrable to water, and within the sections of a single mine thus bounded by clay seams or walls is confined more or less water, and a mine cannot be said to be drained until every one of these seams has been reached by drift and has been penetrated.

Suppose this tunnel, as proposed, should be completed up to the east edge of the lode at the Savage mine, connections between this tunnel at that point and the several mines for the purpose of drainage would render necessary the running of tunnels for that specific purpose at an immense cost to the mines. The Crown Point and Belcher, two of the most productive mines in Gold Hill, could only be reached by a tunnel nearly one mile long. In the opposite directions to the north it would require a tunnel about a half mile in length to reach the Ophir mine.

Down to a level with the Sutro Tunnel, I consider that our present mode of extracting ore through shafts directly over the mines, and by machinery, will be the most direct, expeditions, the cheapest, and that by some addition to the present power the machinery will be amply sufficient to drain and to extract ore down to the level of that tunnel, and even beyond that depth, and that all this will be accomplished before the Sutro Tunnel can, in any reasonable probability, be completed up to the Comstock lode.

If it be contemplated by the projectors of this tunnel, as one of the objects of this enterprise, to have the ore taken out through this tunnel and deposited near the river, to be reduced by water-power in mills to be erected, I would reply, in answer to that view of the case, that a large proportion of ore is now being transported to mills already in operation on the river, over a convenient and substantial surface-railway, instead of being drawn four miles under ground by man or horse power. As to the necessity or advantage of such a tunnel to aid in the working of the mines below its (the tunnel's) own level, so little is known of the extent of the lode downward, and there are so many uncertainties connected with it that it seems like making a costly provision for objects which may not eventually require its construction, even if the present means of hoisting and pumping were not sufficient to work below that level. The above views, formed from long and mature consideration, are respectfully submitted by

Your obedient servant,

T. B. SHAMP,
Superintendent Savage Mining Company.

Major General H. G. WRIGHT,
Senior Officer of Sutro Tunnel Commission.

OFFICE SUTRO TUNNEL COMMISSION,
Virginia City, Nevada, July 28, 1871.

SIR: By the act of Congress approved April 4, 1871, this commission is required to report, among others, upon the following points, viz:

1. The value of the bullion extracted from the mines on the Comstock lode.
2. Their present and probable future production.
3. The geological and practical value of said tunnel as an exploring work.

Much of the information required by the above can be obtained only from the companies engaged in mining on the Comstock lode, and as regards the rest, the information which the companies can afford will be of the highest value to the commission in the discharge of its duties. I am, therefore, instructed to request of you your views, in writing, upon the points above quoted, as well as upon any others which you may deem to have a bearing upon the question of the construction of the Sutro Tunnel.

I also take the liberty, under the instructions of the commission, to append a series of questions having a bearing upon the portions of our duties not enumerated above, your answers to which will be important in making up our estimates of the probable cost of the proposed tunnel, and its value as an aid to deep mining on the Comstock lode.

Should your reply to the foregoing not be ready before the commission leaves Virginia City, please forward it addressed to me at the Army Building, New York City.

The earliest practicable answer will, however, oblige,

Very respectfully, your obedient servant,

H. G. WRIGHT,
Brevet Major General, Senior Officer of Commission.

Colonel T. B. SHAMP,
Superintendent Savage Mine.

The following are the questions to which answers are asked:

1. Cost, at various depths, of sinking shaft, estimated by the cubic foot removed, or by the running foot, for a shaft of given dimensions.
2. The present cost of timbering the same, with the increase, if any, with the depth.
3. The cost of drifting in the various rocks met with in your operations, estimated either by the cubic foot or by the running foot, specifying the dimensions of the cross section.
4. The cost of timbering the same.
5. The daily progress made in the shafts and drifts through the various rocks, the largest force that can be worked to advantage being employed.

6. The cost of raising ore, water, &c., from various depths.
 7. The cost of pumping at your mine for twelve months, preferably for the year ending June 30th, 1871.
 8. Has the water in your mine increased or diminished with the depth, and in what proportion?
 9. The cost per ton of ore for milling, and where the cost of transportation to the mill is included, the cost of the latter.
 10. What is the present cost of the artificial ventilation of your mine, and how does it increase with the depth?
 11. How long a time, at the present progress of working, will it require to exhaust all the profitable ore in the mine above the 600-foot level?
 12. How long, between the 600 and 1,000 foot levels?
 13. At what depth will the present machinery be available for hoisting the ore or clearing the mine from water?
 14. What additional expense will be incurred, if any, per 1,000 feet of additional depth for the purpose above named, calculating from the 1,000 foot level?
 15. What is the width of the lode, and also of productive vein-matter at the various levels of your mine?
 16. What has been the expense of prospecting the mine for the year passed?
 17. How does the pay-ore compare at each level, from the surface downward?
- Answer to question 1. Dimensions of shaft are 28 feet by 8 feet; average cost of sinking, 42 per running foot.
- Answer to question 2. Present cost of timbering shaft, at the depth of 1,300 feet, 14 per running foot. No material increase in this cost for the next few hundred feet.
- Answer to question 3. Cost of drifting in the various rocks from \$6 to \$24 per running foot; average cost on the 1,300-foot level, \$10 per running foot. Dimensions of cross-sections of drifts, 7 feet high, 6½ feet wide at the bottom, and 4½ feet wide at the top.
- Answer to question 4. Cost of timbering drifts \$1 58 per running foot.
- Answer to question 5. Progress in sinking shaft averages 1 running foot per day; progress in running drifts, from 1 to 5 feet running per day, according to the character of the rock.
- Answer to question 6. Cost of raising ore from the 1,300-foot (or lowest) level, \$1 per ton.
- Answer to question 7. Cost of pumping of the year ending June 30, 1871, \$22,337. The present flow of water is 19,116 gallons in twenty-four hours.
- Answer to question 8. The flow of water on the 1,300-foot (or lowest) level is somewhat less than it was on some of the levels above. The proportion in which it has diminished cannot now be accurately ascertained.
- Answer to question 9. The average cost of milling ore for the last year has been \$9 95 per ton, average. This includes transportation, which costs from 75 cents to \$3 per ton, according to the distance.
- Answer to question 10. The present cost of artificial ventilation of the mine is about \$12 per day.
- Answer to question 11. Six month's time, at the present rate of working, will exhaust all the profitable ore in sight above the 600-foot level.
- Answer to question 12. Six month's time will also exhaust all profitable ore in sight between the 600-foot and the 1,000-foot level.
- Answer to question 13. The depth of the present lowest level is 1,300 feet. The present machinery will be available for hoisting ore from a depth 400 feet below this level, and for pumping the mine 1,500 feet deeper.
- Answer to question 14. The chief additional expense of hoisting ore, and pumping from a depth 1,000 feet below the 1,000-foot level will be the extra steam power required, and that is estimated to be but a small fractional proportion of the power required in hoisting and pumping from the 1,000-foot level.
- Answer to question 15. The width of the productive vein-matter on the several levels which have been worked has varied from 4 feet to 40 feet.
- Answer to question 16. The expense of prospecting the mine for the year ending June 30, 1871, was \$116,371.
- Answer to question 17. The value of the ore per ton has diminished from the upper levels downward.

T. B. SHAMP,
Superintendent Savage Mining Company.

VIRGINIA CITY, NEVADA, *September 16, 1871.*

APPENDIX F.

OFFICE HALE & NORCROSS'S SILVER-MINING COMPANY,
Virginia, October 3, 1871.

DEAR SIR: In reply to your printed circular, received last month, I will state to

questions Nos. 1 and 2: The size of our main shaft is 6 feet wide and 18 feet long, divided into three compartments. The cost of sinking this shaft has been \$23 25 per foot, and of timbering the same \$16 50 per foot, and, from the limited quantity of material possible to be excavated from a piece of ground of those dimensions, (necessarily employing the hoisting power only a small part of the time, and not continuously,) the increase in cost of sinking the shaft has not been perceptible, particularly as water does not impede this work to so great an extent as when advancing downward near the surface.

Question No. 3. The average dimensions of our drifts and tunnels are $5\frac{1}{2}$ feet wide and $7\frac{1}{2}$ feet high. The average cost of running these drifts is \$3 per foot.

Question No. 4. The cost of timbering these drifts is \$2 per running foot.

Question No. 5. From 3 to 12 feet per day is the distance run in these drifts, according to hours worked and character of the material penetrated.

Question No. 6. The cost of hoisting ore from present station is 50 cents per ton, and has not greatly varied therefrom when extracted from the upper levels.

Question No. 7. For the year ending June 30, 1871, the cost of pumping water has been \$2,320.

Question No. 8. The water to be pumped is less than when working near the surface; it is about one-sixth of the former volume.

Question No. 9. This company has paid from \$9 to \$12 per ton for milling its ores. (The mills pay their own transportation, which has been from 65 cents to \$1 10 per ton.)

Question No. 10. As yet no increase in cost of ventilating the mine is noticed; the expense has averaged us \$4 per day.

Question No. 11. About five years.

Question No. 12. About three years.

Question No. 13. To a depth of 2,500 feet this company has nearly completed the placing of ponderous machinery to aid in the prospecting of the mine at greater depths. We have no ropes of that length yet, but will have them made long before required. Our reels are adapted to such lengths, being flat-steel wire-ropes.

Question No. 14. To a depth of 500 feet below our present lowest level (called the 1,300-foot level) no particular augmentation of expense will be necessary. For a greater depth I cannot at present state.

Question No. 15. The width of our pay-vein was, at 100 feet in depth, 90 feet; 200 feet in depth, 80 feet; 300 feet in depth, 50 feet; 1,200 feet in depth, 45 feet; 1,300 feet in depth, 80 feet.

Question No. 16. Our prospecting expenses for the year have been \$147,000.

Question No. 17. The pay-ore lessens in value as we descend. It then increases in value, and again lessens to a still greater extent.

Very respectfully, yours,

J. G. FAIR, *Superintendent.*

Mr. H. G. WRIGHT,
Army Building, New York.

APPENDIX G.

OFFICE CHOLLAR POTOSI MINING COMPANY,
Virginia City, Nevada, September —, 1871.

RESPECTED SIR: In compliance with your request made at this place I herewith submit the following as answers to the various questions contained in your circular bearing date at Virginia City, Nevada, July 28, 1871:

CONGRESSIONAL QUESTIONS.

Question No. 1. Value of bullion extracted from mines on the Comstock lode.

Answer. Total amount of bullion extracted from this mine is \$11,772,105 47.

Question No. 2. Their present and probable future production.

Answer. For the twelve months ending May 31, A. D. 1871, the average monthly yield of bullion was \$288,285 25. For the months of June and July following the bullion production averaged \$166,312. The future yield of bullion necessarily depends on the success of prospecting. At this writing indications are positively and decidedly against the hope that any twelve months in the future will nearly equal the production of the past year.

Question No. 3. The geological and practical value of said tunnel as an exploring work.

Answer. *Geologically*, science may derive information of value to students in that branch of learning, although the probabilities strongly favor the opinion that the same geological knowledge can be acquired more easily and at vastly less expense. *Practically* considered, after many years experience in mining—five of which have been exclusively devoted to the Comstock lode, in directing and super-

intending mining operations—being thus employed, opportunities were abundant to gain a knowledge of the formations and to study the nature of the various deposits that make up this lode. Also, to satisfactorily determine water-sources that have supplied the subterranean reservoirs met with in explorations along this river.

The result of this experience dictates the follow conclusions: That the proposed adit known as the Sutro Tunnel is not now, and never will be, a necessity to the lode, either for prospecting purposes, ventilation, or for the economical handling of metal-bearing material, waste or débris or as a means of entry or exit for men to the various mines located on the Comstock. The reasons why said adit is not needed for prospecting purposes: This company have a shaft and incline sunk immediately on the lode to the vertical depth, from the top of the shaft, of 1,250 or 1418 feet from point [A] as designated on Clarence King's atlas of Mining Industry. The shaft is located near the center of this company's claim; that is, so far as a north and south line is considered. For a better understanding of the location of the shaft, and the explorations carried on from the same, reference is hereby made to the atlas mentioned above. From this shaft explorations have been, and always can be, carried on with far greater economy, more safety, and in a more satisfactory manner than could be done through the proposed adit, owing to the fact that the shaft, being on and passing through the lode, we have our entire operations, as it were, in a "nut-shell." Stations are made at each hundred feet in depth; from these, drifts are driven running north and south, east and west, or at any other point of the compass desired. From these drifts, as they are pushed on, we can and do gather daily information of the value of material passed through; the condition and prospect of the lode for the next level. Through this shaft we pass our men to the various sections of the mine allotted to them. Down here goes all the timber used in all portions of slopes, drifts, and winges, also the tools; in short, everything needed for the perfect working of the mine. By aid of machinery at the surface all of this work is done. Allow me to ask how would it be to run in timber four miles through a tunnel, and hoist the same up seventeen hundred feet vertically, as we would be compelled to do—this company having done no work for two years last past below the 200-foot level of their shaft—and from there distribute them through the mine. Presuming we were down on the 1,000-foot level extracting ore, and this tunnel, as is proposed, the means of entry and exit for ore, men, and timber, we would then be compelled to hoist our timber 800 feet by hand—as the projector of the tunnel assumes that no machinery is required to operate the mines after the tunnel is complete—and the poor toiling miner must climb up by sheer muscle-power the same distance. Imagine, if you can, hundreds, ay, thousands of men climbing up and down these vertical ladders distances varying from five to seventeen hundred feet¹ and then compare it with the ease and safety that they are placed at the various stations in the shaft by the aid of machinery we now have in use at our mine; and does it not comport with good economy to spend the muscle-power at the face of drifts, or in the slopes, rather than exhaust the energies of your men climbing up and down immense vertical heights on ladders? Hence I assert, without fear of successful contradiction, that for the purpose of exploring this lode the proposed tunnel would prove a positive failure.

Concerning the country east of the Comstock, and through which this proposed adit is supposed to pass, I claim no knowledge. All reasoning on what exists at great depths east must necessarily be theoretical. My conclusions are that, at the depth this proposed tunnel would come, no precious metal exists outside of the main vein. Some prominent croppings eastward have been operated on most of the time during the past eleven years. The few hundred feet in depth that have been attained on them resulted in practically exhausting the extremely limited amount of precious metals, and in nearly every instance has been the financial ruin of those interested.

To illustrate the supposed benefits to be derived from this proposed tunnel for ventilation, we will assume that the same is completed along the whole line, and connected with each shaft—a bold assumption, I grant—the currents of air supposed to be passing rapidly through the tunnel and shafts, with all this imaginary air passing through these funnels, not a particle can be had at the slope we are working 700 feet west, as is the case in this claim, of the shaft. To get air in a slope or drift away from the shaft machinery must be used. All practical miners are aware of this fact, consequently the applying of compressed-air machinery for ventilating these mines, and using the engine in deep levels to hoist with is being considered, and will, no doubt, if the prospects of the lode justify, be soon put in operation. With this machinery, and a connection of the various shafts, a more perfect system of ventilation will be secured than any other method can afford, and at an expense that would be considered as nothing when compared with the expense attending the very imperfect manner of ventilation as proposed by the owners of the "adit franchise."

Handling of ore.—Please, sir, come with me and examine the matter of passing the ore that this company is now mining, or ever has mined, through this proposed tunnel. We start at the mouth of this company's shaft, and go down 178 feet; here is the station. We leave the shaft, and go in west 16° south for 700 feet; here we are under where the large body of ore known as the Belvedere existed. North of us to the

company's north line, and down below us 280 feet, making 458 feet in depth from mouth to shaft, is the section of country from which all the ore has been taken that produced the nearly \$12,000,000 in bullion mentioned in the beginning as the gross product of the mine. Below this 458-foot level, we have gone 800 feet without finding ore, and as we attained depth the more discouraging our prospects became. That is why two years have passed without our making an effort to sink further. Had even the slightest encouragement been developed, we should have continued the sinking, and would have been at this date 300 feet below the level of the proposed tunnel.

Pardon this digression. Let us return to the point 700 feet west of the shaft, and consider the proposition of running this ore from here to the shaft, and dumping the same down a chute 2,000 feet in length. Why so long? Because the chute must be on an angle of 45° to conform to the west wall, and to reach the tunnel from this level at the shaft. Can a chute be made to work that distance and on that angle? We practical miners would promptly say, no, sir; as we find it very difficult to maintain chutes 300 or 400 feet in length standing vertical. Do we ever make them on angle? Never at 45° , and never on any angle if we can avoid it, as they clog and wear much more quickly than vertical ones. Sir, permit me to ask, would you not consider us guilty of the most consummate folly to chute this ore down 2,000 feet (if it could be done) to this proposed tunnel, and run it out four miles for the privilege of hauling up heavy hills to mills, when we can run the car loaded with ore on the cage, hoist to the surface, 178 feet, place the ore in dumps made purposely to facilitate the loading of railroad cars or teams, and from this point the hauling is all the way down hill? What does it cost for hoisting from this level? During the month of July we hoisted 3,000 tons from here, drove the engine to run the blower for ventilating the drifts. To make steam necessary for this work ten cords of wood were consumed, or one-third of a cord each twenty-four hours. As you will notice, one car goes up, while the car in the next compartment of the shaft comes down. This arrangement makes hoisting easy, also very economical, and can be made to work equally well at 2,000 feet in depth as it does here at 200 feet. Fact is, the matter of hoisting from any depth up to 3,000 feet can be easily accomplished. How to get the ore out from these deep levels is not the important question on the Comstock. To find the ore to hoist, that is where the insurmountable difficulty comes in. To solve that problem requires more brain, muscle, and money than all other operations along the vein put together. Show us the ore, even at the depth of 3,000 feet, and I will give you a pledge, sir, that we will never ask how shall we get this ore out. Relative to this proposed adit as a means of entry and exit for men, the remarks already made are perhaps quite sufficient on that point. In brief, the whole tunnel project is simply impracticable, unnecessary, and totally uncalled for except as a drain. Here a few words will be applicable concerning the water-source and subterranean reservoirs that have been met with. All water found in this mine has been in reservoirs; these were formed by the clays uniting, so that in shape they represented huge basins. The water-supplies came from the surface. Melting of snows for thousands of years formed the water which circulated to and filled these reservoirs. Prospecting drifts pierced the clays and tapped these water deposits, and drained them, at the various stations, until the clays reached the west wall, which terminated the reservoirs. Below the 1,000-foot level in this mine water was not met with. On the 1,250-foot level there was no natural moisture. The Bullion claims, first adjoining us on the south, reached in depth 100 feet below our 1,250-foot station. At that point the earth was so intensely dry that dust caused from the working pervaded the drift, very much to the discomfort of the miners in said drift. If, in review, these facts are given their proper weight, the conclusions naturally follow that the construction of an immense adit to drain the Chollar Potosi mine would be superfluous.

To the best of our knowledge we have made answer to the congressional questions. We must next proceed to answer those interrogatories propounded by your honorable body.

COMMISSION QUESTIONS.

Question No. 1. Cost, at various depths, of sinking shafts estimated by the cubic foot removed, or by the running foot, for a shaft of given dimensions?

To give answer to this I will take the main incline, which commences at a point 891 feet down from mouth of shaft, and continues down on an angle of 45° to the east, a distance of 612 feet, at which point is our deepest level. Size of excavation is 14 feet in width, 9 feet in height. This excavation, as timbered, forms two compartments. The one on the pump side is 6 feet in height, in clear of timbers, by 6 feet in width, in clear of timbers. The other, the hoisting compartment, is 6 feet in height by 4 feet in width.

Excavation cost per running or lineal foot	\$20 00
Timber, 200 feet, at $2\frac{1}{2}$ cents per lineal foot	5 00
Timber framing and setting, per lineal foot	5 00
Wear and tear of machinery, oils, and incidentals	5 00

Total cost per running or lineal foot 35 00

These figures represent the average cost per lineal foot for running said incline from the beginning to the completion, or the entire length of 612 feet. Had we taken down other two compartments to correspond with the main or vertical shaft, the expense would not have been so great proportionally. Material passed through was syenite.

Question No. 2. The present cost of timbering the same with the increase, if any, with the depth.

Answer to this question was merged in the answer made to No. 1, except "the increased cost of timbering as depth is attained." Practically speaking there is no increase in the cost.

Question No. 3. The cost of drifting, in the various rocks met with in your operations, estimated either by the cubic foot or by the running foot, specifying the dimensions of the cross-section."

Answer. In answering this question I will take as an example our drift at the 178-foot station, the same that you passed through when you visited the mine. The drift is 700 feet in length from shaft to Belvidere country. In making the drift all the material common to this section outside of the lode was passed through, such as andesite, quartzite, porphyry, and clay. The following figures show the cost per running or lineal foot:

	Per foot.
Running drift by contract, contractors furnishing candles	\$3 75
Timber and framing	1 85
Sharpening tools	1 00
Hoist and deposit earth	3 00
Total cost per foot	9 60

Size of drift outside of timbers is 6 feet 6 inches by 9 feet 5 inches by 5 feet 6 inches, (6 feet 6 by 9 feet 5 by 5 feet 6.) A diagram of shape and size of timber in drift was handed you. With your consent I make reference to said diagram to show size of drift in clear of timber.

Question No. 4. The cost of timbering the same.

Answer. As noted above, the timber and framing cost \$1 85 per lineal foot. The putting of them in place was included in the contract for running.

Question No. 5. The daily progress made in the shafts and drifts through the various rocks, the largest force that can be worked to advantage being employed.

Answer. In drift from shaft at 178-foot station the average progress was 6 feet 6 inches—6½ feet each twenty-four hours. In sinking the incline, average progress was 4 feet 8 inches each twenty-four hours. At both the incline and drift all was done that could be to hasten progress.

Question No. 6. The cost of raising ore, water, &c., from various depths.

Answer. At the 1,250-foot station material was taken up the incline, placed on the cages in shaft, and taken to the surface for an actual cost of 38 cents per ton. Had we succeeded in finding ore there in sufficient quantities to have kept the machinery steadily employed, 35 cents per ton would cover the cost of hoisting. The water quantity was so limited when we were operating in low levels that for weeks together the pumps would run one hour only out of the twenty-four. No record was kept of that expense.

Question No. 7. The cost of pumping at your mine for twelve months, preferably for the year ending June 30, 1871.

Answer. For two years last past this mine has been entirely exempted from pumping.

Question No. 8. Has the water in your mine increased or diminished with the depth, and in what proportion?

Answer. As depth was attained water diminished; at the lowest level there was no water.

Question No. 9. The cost per ton of ore for milling, and, where the cost of transportation to the mills is included, the cost of the latter.

Answer. For the year ending May 31, 1871, this company paid \$12 per ton for the milling and transportation of their ore. What the cost of transportation was I know not.

Question No. 10. What is the present cost of artificial ventilation of your mine, and how does it increase with the depth?

Answer. The points ventilated in this mine artificially at this time are three; expense attending same is 75 cents per day. The cost of ventilation at the deepest levels was \$6 per day.

Question No. 11. How long a time, at the present progress of working, will it require to exhaust all the profitable ore in the mine above the 600-foot level?

Answer. At present rate of working, three years' time will exhaust all the ore in the mine; that is, all the ore that is known to exist.

Question No. 12. How long between the 600 and 1,000-foot levels?

Answer. Up to this date no ore worthy of mention has been found below the 600-foot level.

Question No. 13. At what depth will present machinery be available for hoisting the ore or clearing the mine from water?

Answer. Two thousand and two hundred feet vertically; that is, the machine we had in use when the work at lower levels was being prosecuted would have been sufficient to have reached the distance above stated.

To question No. 14 answer will be omitted, for the reason that, all work at our lower levels being suspended, to attempt to make answer could be nothing more than guessing.

Question No. 15. What is the width of the lode, and also of productive view matter, at the various levels in your mines?

Answer. The width of the Comstock is a matter that is to-day entirely undecided. The productive view matter in this mine has averaged about 45 feet in width.

Question No. 16. What has been the expense of prospecting the mine for the year past?

Answer. For the year ending last 31st of May, \$143,800 were expended in repairs, prospecting, dead work, and incidentals. About \$100,000 of that amount was spent strictly for prospecting.

Question No. 17. How does the pay-ore compare at each level, from the surface downward?

Answer. The best ore produced by this mine, both as to quantity and quality, was taken out from the surface downward to the 300-foot level. Below that point the ore diminished in quantity and quality until it ran out.

Having concluded and made answers to the best of my understanding of your questions, I beg leave to say that should some of the answers prove to you vague, I will be most happy to make further explanation, if you will at any time, by letter or otherwise, signify your desire for such. Permit me to add further, that by referring to Clarence King's Mining Industry, or the Annual Report of this company, you may gather the information to make clear what may prove cloudy to you in some answers I have made.

I am, sir, very respectfully, yours,

ISAAC L. REQUA,

Superintendent of Chollar Potosi Mine.

Brevet Major General H. G. WRIGHT,

Senior officer of Sutro Tunnel Commission.

EXPLANATION.

On folio 20 the cost of hoisting from the 1,250-foot level is 35 cents per ton. This work was done thirty months ago. At that time wood was \$14 per cord; now the price is \$10. Other expenses were larger then than now.

Beyond a doubt further reductions in cost of fuel will be made; also other expenses which will so far economize operations that 25 cents would cover the actual expense of hoisting per ton from the 1,250-foot level.

I beg your indulgence to express to your honorable committee my firm conviction concerning the utility of the proposed tunnel. If said tunnel, with the proposed lateral branches, was now complete, and the owners of the tunnel should sign a compact with the mine-owner agreeing to relinquish their right to collect royalty, also that the mine-owners should have the right of way through said adit to run ore-timber, &c., and that tolls for use of said tunnel should not be collected, I am sure true economy would then be to hoist the ore by machinery to the surface as we are now doing.

Not wishing to exhaust your patience by dry figures to prove the above conclusions, I will simply say that proof abundant can be given to substantiate the assertion.

Respectfully, yours,

ISAAC L. REQUA.

OFFICE CHOLLAR POTOSI MINING-COMPANY,
Virginia, Nevada, July 21, 1871.

Gentlemen of the Sutro Tunnel Commission:

In reply to your questions concerning the cost of running the tunnel on the first station from new shaft of Chollar Potosi Mining Company west 700 feet, I beg leave to submit the following as the total cost per foot:

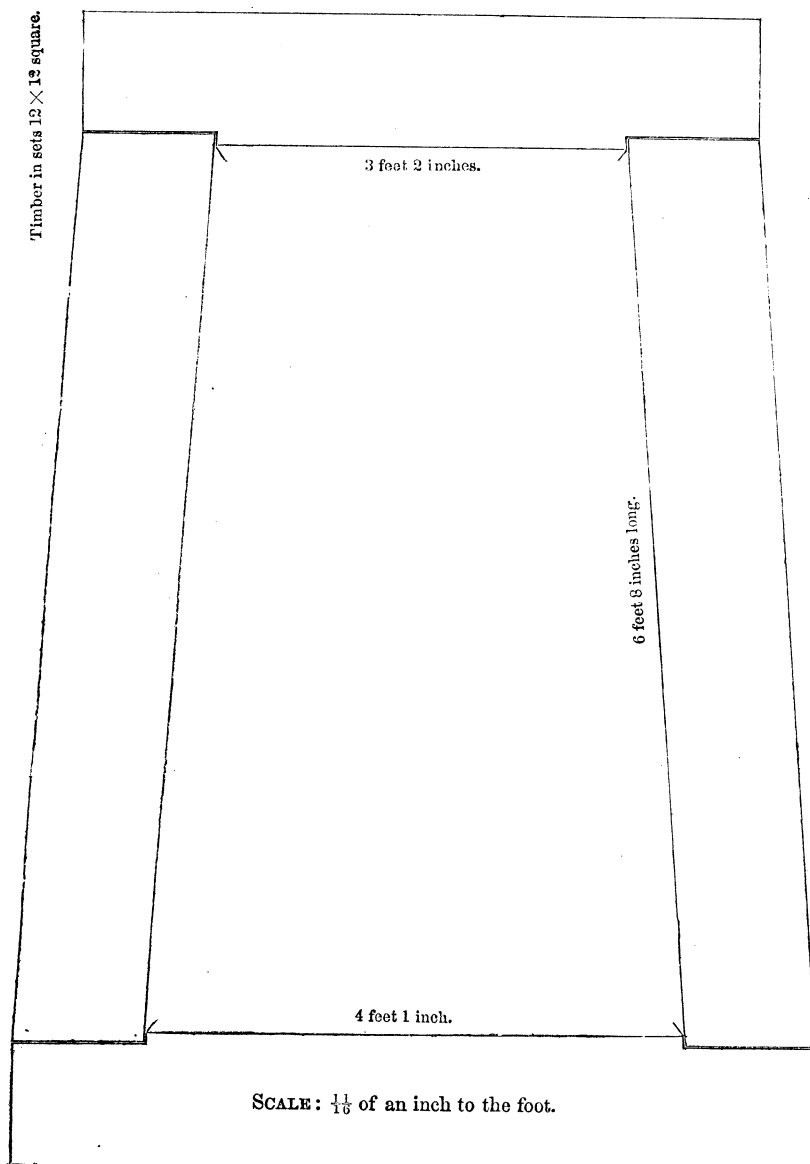
	Per linear foot.
Running drift by contract, contractors provide candles.....	\$3 75
Timber and framing.....	1 85
Sharpening tools.....	1 00
Hoist and deposit earth.....	3 00
Total.....	9 60

SUTRO TUNNEL.

Size of drift outside of timbers is 6 feet 6 inches by 9 feet 5 inches by 5 feet 6 inches
The diagram connected gives the size in clear of timber.

Respectfully, yours,

ISAAC L. REQUA.
Superintendent.



APPENDIX H.

GOLD HILL, NEVADA, October 4, 1871.

DEAR SIR: The following are my answers to your various questions, which I have endeavored to answer as correctly as possible:

The Imperial and Empire shaft, $7\frac{1}{2}$ by 20 feet outside of timbers, containing 150 cubic feet to each running foot, was sunk between the 1,200 and 1,300-foot levels for 36 cents per foot, all in very hard blasting rock, or 24 cents per cubic foot, including labor of timbering. This portion of the shaft was sunk in the vein where the quartz was very hard, and a large quantity of water to contend with. In good ground the same shaft can be sunk for 15 cents per cubic foot, including labor of timbering, or \$18 90 per running foot.

No. 2. The cost to timber a shaft $7\frac{1}{2}$ by 20 outside of timbers, for 100 running feet, will require 15,000 feet of 12 by 12 and 10 by 15, and 11,200 feet of plank, equal to $2\frac{1}{2}$ feet of timber for each cubic foot of earth removed. Heavy ground will, of course, require more timber.

No. 3. The cost of drifting varies under so many different circumstances it is next to impossible to give a correct estimate. The size of our drifts, usually 6 by 9 outside of timber, with good cool air, can be run for \$7 per foot in hard blasting ground. The same ground with thermometer 110° will cost \$32 per running foot, or 59 cents per cubic foot.

No. 4. Cost of timbering the above drifts with sets 5 feet from centers would be \$3 24 per running foot, or 6 cents per cubic foot.

No. 5. Daily progress in good air, 7 feet; thermometer 110° , 18 inches to 2 feet.

No. 6. The cost of raising ore, &c., from 1,300-foot level to the surface is 27 cents per ton; that is, running our present machinery full capacity. Estimated cost from 2,000-foot level, 50 cents per ton. This estimate includes every expense except wear and tear of machinery.

No. 7. The cost of raising the water for the past year is difficult to get at. Not having any pumps it was raised to the service with a tank which we run only when absolutely necessary.

No. 8. See no perceptible change in water from 250-foot level to 1,300-foot level; if any, it has decreased.

No. 9. Company mill; cost of milling, \$7 90, including hauling, which was 45 cents per ton.

No. 10. Cost of artificial ventilation: one Root's blower, \$18 per day, carrying air to 1,340-foot level.

No. 11. All the available ore from the 600-foot level to the surface is exhausted, unless the cost of milling be reduced.

No. 12. From 600-foot level to our present lowest or 1,300-foot level, the vein in Imperial and Empire mines has been comparatively barren.

No. 13. Our present machinery in use at the mine will be available for hoisting to a depth of at least 2,500 feet.

No. 14. The width of the lode at the various levels varies; on 700-foot level the vein was 425 feet between walls; on 900-foot level, 308; on 1,300-foot level, 150 feet from east to west wall; productive vein-matter varies in width.

No. 15. The cost of prospecting for the year past was about \$110,000.

No. 16. The pay-ore was quite uniform from the surface down to 700-foot level, where the vein had got to be so very wide and ore so scattered it could not be made to pay. The vein seems to be getting more concentrated as we go deeper.

Very respectfully, yours, &c.,

R. N. GRAVES,

Superintendent Imperial and Empire Mines.

Brevet Major General H. G. WRIGHT,

Sutro Tunnel Commissioner.

APPENDIX I.

GOLD HILL, August 31, 1871.

DEAR SIR: Your favor of 28th ultimo duly received, and all your questions noted and answered as follows, as concisely as possible with regard to accuracy:

The value of bullion extracted from the Yellow Jacket mine since date of incorporation in February, 1863, as per books of company, was \$12,772,172
 Bullion from ore sold since the above date, and product of mine previous to the same, estimated at..... 1,500,000

Total amount of bullion..... 14,272,172

The present yield of the mine is about \$180,000 per month, or about \$2,000,000 per year. The probable future yield will no doubt equal the past.

The geological value of the tunnel will consist in its showing a section of the country twenty-two hundred (thousand?) (22,000) feet east of the Comstock lode, a longer section than is probably shown by any similar work in the United States, and consequently of value to science. The practical value of said tunnel will be its use as an adit for the lode; as a means of ventilation it will be of value to any mine connecting its workings with the tunnel, but I think of no more value than the connections for air passages between the several shafts, as at present made. For the purposes of extracting ore above the tunnel level, it will be of very little value. We find that chutes over 150 feet in length are very expensive to keep in repair and open. Chutes of even that length are apt to become choked, when there is great danger and difficulty in clearing them, for which reason we seldom make our working levels more than 100 feet apart, (vertical,) or about 140 feet on slope of lode. Another objection is the additional labor of climbing and upraising of tools and timbers.

The cost of sinking shafts varies under so many different circumstances that I can only give practical results that I can obtain from present and former work. A shaft 7 by 18 feet outside of timbers, or full size, can be sunk for \$17 64 per running foot, or 14 cents per cubic foot of earth removed. This is in blasting ground, and includes labor of timbering.

Yellow Jacket shaft, between 1,000 and 1,100-foot levels, 8 by 24 feet, full size, was sunk for \$27 per running foot, or about 14 cents per cubic foot, all blasting ground. Temperature of air 93°, labor of timbering included.

Incline below 1,100-foot level, full size, 9 by 14 feet, an angle of 45°, all blasting ground, sunk for \$20 per running foot, or 15½ cents per cubic foot. Average 3½ feet per day; four shifts of six hours each, four men each.

The cost of timbering such ground as the above, that is, cost of timber and framing the same, will be about 3 feet of timber (lumber or board measure) for each cubic foot of earth removed, or say 10 cents per cubic foot of shaft. Heavy clay or swelling ground will require twice the same.

The cost of drifting, like cost of sinking shafts, depends on character of ground and temperature of air. Have run drifts in hard blasting ground, (cool air, size full,) 6 by 9, for \$7 per running foot, or 13 cents per cubic foot of earth removed. Same ground, with temperature of air 107°, cost \$30 per running foot, or 55½ cents per cubic foot, cost of labor of timbering included in the above. With cool air made 3½ feet per day; with air at 107°, 20 feet per month.

Cost of timber for drift above size (6 by 9 feet) will be \$3 42 per running foot, or 6½ cents per cubic foot. Have run drifts the above dimensions, good working ground, and timber the same, 10 feet per twenty-four hours.

The cost of raising ore, waste, &c., the past ten days, from 1,130-foot level to the surface, (3,025 tons,) was 37½ cents per ton of 2,000 pounds. Estimate that we can raise ore, &c., from 2,000-foot level for 64 cents per ton. The above includes all cost of engineers, brakeman, firemen, fuel, water, oils, &c., but not wear and tear. Can raise or lower men to 2,000-foot level, in four minutes, for 6 cents per man.

The cost of pumping the past year at Yellow Jacket mine has been very small. Have not run pumps for sixty days at a time. Water of whole mine has not exceeded 1 inch (miner's measure, 6-inch pressure) the whole year.

The water in the mine has decreased from 20 inches, at 250-foot level, to less than 1 inch, 1,130-foot level; (miner's measure, 6-inch pressure.)

The cost of milling at present is \$12 per ton. Cost of transportation to river mills is about \$2 50 per ton; to steam mills within county lines, about 60 cents per ton. Cost of transportation, included in cost of milling ore, \$12.

Cost of running two of Root's patent blowers, No. 3 and No. 5, is about \$12 per day. Carry air to four different points; nearest 1,300 feet from blower; most distant 2,200 feet. I am unable to state how long a time it will take to exhaust all profitable ore above 600-foot level, or between 600 and 1,000 foot levels. I am ignorant of the quantity in place.

The present machinery in use at the mine, with addition of necessary pumps, ropes, &c., will be available for hoisting and pumping to a depth of 2,500 feet from surface.

The width of the lode at the various levels has never been definitely determined. Have made a cross-section of over 400 feet on 1,000-foot level without finding either side or wall. Productive vein-matter has varied from 12 inches to 24 feet in width.

The cost of prospecting the mine the past year has been about 30 per cent. of the whole expense of mine for labor and cost of materials, or say \$172,000.

Pay-ore has been very regular from the surface to 1,100-foot level.

You will please excuse my tardiness in replying to your various questions. Absence and want of time are my only excuse.

Yours, respectfully,

THOMAS G. TAYLOR, *Superintendent.*

Brevet Major General H. G. WRIGHT,
Sutro Tunnel Commissioner.

APPENDIX J.

OFFICE OF STATE SURVEYOR GENERAL AND LAND REGISTER,
Carson City, Nevada, November 8, 1871.

SIR: In reply to your inquiries, hereinafter given, and numbered from 1 to 7, I have to make the following report:

"1st. The fall of Carson River from the Mexican Dam to the best location for a large dam above and nearest to Dayton. (This is probably at the point where the Franklin Mill-dam now is.)"

The fall is 155 feet from Mexican Dam to the Franklin Dam.

"2d. The fall of Carson River from the point selected for a large dam to a point opposite the Sutro Tunnel."

The point selected is the Franklin Dam. Fall of river from this point to a point opposite Sutro Tunnel is 100 feet.

"3d. The height of high water in the river when highest and when lowest; also the height in each month of the year, if possible to be ascertained, and the rapidity of flow at these different times."

The average flow, taking one year with another, is as follows, estimated in square-feet section, with a velocity of four miles per hour: In the month of May, 600 square feet; in June, 700; in July, 700; in August, 600; in September, 500; in October, 500; in November, 400; in December, 400; in January, 400; in February, 400; in March, 400; and in April, 500. This gives an average monthly section of 508.33 square feet, with the velocity as above given. The perpendicular rise and fall of the river per month cannot be given, but the extremes of highest water in floods and lowest water in drought are from 8 to 10 feet in the average width of the channel.

I would state that the amount of water flowing in the Carson River this year is extremely small—far less than ever known since the settlement of the State; and it is not probable that a similar reduction will happen in many years. I have, therefore, based no estimate or calculation upon this year. For the months of August, September, and October, and up to the present time, the flow has been only 25 cubic feet on a grade of 10 feet to the mile.

"4th. The cross-section of the river, at the best point for a large dam, to be sufficiently large and high to hold all the water to the level of the Mexican Dam."

This cross-section is selected as the Franklin Dam, and is shown on accompanying diagram.

"5th. Approximate area in square miles of the reservoir or lake thus created."

Exclusive of any overflow at the town of Empire, a tract 15 chains wide, and eleven and three-quarters miles long from Mexican Dam to the proposed large dam, the surface of water thus created would be 1,410 acres, or two and one-fifth square miles.

"6th. Estimated dimensions and cost of dam to answer the above purpose."

This dam should be 837 feet long and 155 feet high, (see accompanying diagram,) and would cost not less than \$200,000. But by moving the site one mile up the river from the Franklin Dam, the dimensions and expense would be greatly reduced.

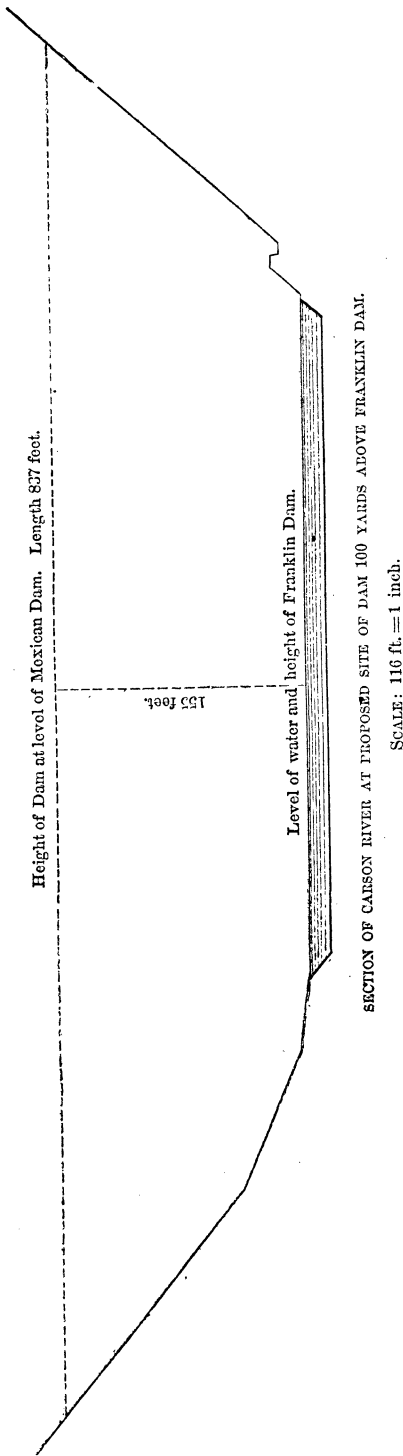
"7th. Length of canal from location of dam to the mouth of the tunnel, including its windings in following the horizontal curve; also, size of canal in order to carry off the average and accumulated flow of water; also, estimated cost of construction of canal."

The length of canal would be five and one-half miles. The size of canal would be a cross-section of 600 square feet. The cost of construction of canal, taking a mean average between excavating and fluming, would be \$250,000.

With the exception of the fall of river and distances herein given, the estimates could only be approximated; want of time has prevented my making a careful and accurate estimate.

JOHN DAY,
Surveyor General State of Nevada.

ADOLPH SUTRO, Esq.,
San Francisco, California.



APPENDIX K.

[3,185 feet of tunnel, (including open cut.) cost, \$42,800 78; commencing October 20, 1869; ending July 1, 1871.]

Character of ground developed.	Respective distances.	Average cost of sup'ly, foreman, and labor per foot.	Total cost for superintendent, foreman, and labor.	Average cost for frame-timber per foot.	Total cost for frame-timber.	Average cost of iron, steel, tools, oils, and candles per foot.	Total tools, and candles.	Average cost of track-timber per foot.	Total cost of track-timber.	Average cost of track-iron per foot.	Total cost of track-iron.	Average cost of wood per foot.	Total cost of wood.	Average cost of charcoal per foot.	Total cost of charcoal.	Average cost of powder, fuse, and caps per foot.	Total cost of powder, &c.	Average cost per foot.	Total cost for completing 2,185 feet of tunnel.	Total number of days worked by miners alone.	Total length of calendar time.	Average feet of tunnel each day.	
Trachytic conglomerate.	750	\$14 10	\$10,574 00	.....	.....	\$1 00+	\$57 +	17 87	\$134 +	52 31	\$177 +	.....	.....	.....	\$103 +	5	\$37 50	\$15 70	.....	1,255	109	7
Trachyte	500	16 87	8,435 00	.....	.....	1 00+	504 +	17 87	89 +	22 31	111 +	.....	.....	.....	70 +	5	200	18 82+	.....	1,140	104	5
Trap dike	40	12 84	513 60	\$1 48	\$59 20	1 00+	40 48	17 87	7 15	22 31	8 92	.....	.....	.....	4 46	3	1 20	16 30+	.....	138	10	4
Red clay	70	16 55	1,158 50	1 48	103 60	1 00+	70 65	17 87	12 50	22 31	15 61	.....	.....	.....	7 80	3	1 20	30 31+	.....	164	70	4
Blue clay	100	18 36	1,835 00	1 48	148 00	1 00+	100 94	17 87	17 87	22 31	22 31	.....	.....	.....	11 15	3	3 00	32 19+	.....	212	14	5
Porphyry, timbered.	342	18 44	6,305 48	1 48	506 16	1 00+	345 25	17 87	61 13	22 31	76 30	.....	.....	.....	68 40+	0	171 +	32 76+	.....	206	98	3
Porphyry, hard	383	19 05	7,296 15	.....	.....	1 00+	386 30	17 87	68 53	22 31	85 45	.....	.....	.....	76 60	0	63 30	242 44	.....	232	138	3
Extra, for open cut						1 00+									76 60	0	63 30	242 44	.....	773	143	2
						1 00+									76 60	0	63 30	242 44	.....	1,099	14	7
Total	2,185		36,118 73		816 96	2,204 62	390 16	496 59	674 21	343 41	657 24	42,800 78	4,448	546	4 + 15

Respectfully,

The Honorable THE SUTRO TUNNEL COMMISSION.

J. C. HAZLETT.

APPENDIX L.

The following estimate is based upon four miles or 21,120 running feet of the Sutro Tunnel complete :

The large timbers are 12 inches square, and are set 5 feet apart from center to center. The lagging are 3 inches thick, 6 inches wide, and 5 feet long, containing lumber as follows, to wit :

	Feet.
4,225 bents, containing 840 feet each	3,549,000
4,225 bents lagged, containing 570 feet each	2,407,680
8,450 supports for track, containing 36 feet each	304,200
84,480 lineal feet, or 16 miles, track timber, 6 by 6	253,440
	<u>5</u>
Total feet	6,14,320
	<u>260,572 80</u>
At \$40 per M.	105,625 00
4,225 bents properly in place, at \$25 each	
	<u>366,197 80</u>
Total cost	<u>\$17,33.88</u>
Cost per linear foot	

Respectfully,

J. C. HAZLETT.

The Hon. THE SUTRO TUNNEL COMMISSIONERS.

APPENDIX M.

SAN FRANCISCO, CALIFORNIA, *November 23, 1871.*

MY DEAR SIR: It was my intention to avail myself of the opportunity to present some additional statements in regard to the Sutro Tunnel, but my time has been so very much occupied since my return to California that it has been almost impossible for me to find the necessary leisure.

I think now that I shall have to reply to the statements of some of the superintendents of the mines on the Comstock lode after your report is published, so I may ascertain what position they take; my reply, of course, can then form no part of your report.

You are, no doubt, well aware of the continued and persistent prevarications of the men who oppose the great work in which I am engaged; and since I have given a complete history of the tunnel enterprise and the motives for that opposition in a speech delivered by me at Virginia City, Nevada, some time ago, I inclose a copy of the same, and would respectfully ask to have the same embodied in the appendix to your report.

That a work of the magnitude of the Sutro Tunnel, which will radically change the mode of working the mines, should find much local opposition, cannot be wondered at. It is the old fight of stage-coaches against railroads, and such fights will always take place as long as improvements are contemplated.

I forwarded to you some days ago estimates of the cost of large dam across Cañon River, with other statistical information about the water-power on the river, which I hope has duly reached you.

I am, dear sir, your most obedient servant,

ADOLPH SUTRO.

Major General H. G. WRIGHT,
Senior Officer Sutro Tunnel Commissioners.

SPEECH OF ADOLPH SUTRO, ON THE SUTRO TUNNEL AND THE BANK OF CALIFORNIA.

FELLOW-CITIZENS: For some years past I have been closely identified with an enterprise which has a vital bearing upon the prosperity of this section of country, and if I appear before you now for the first time in my life as a public speaker, it is with a thorough conviction that upon its success depends your future welfare.

You have all heard of the Sutro Tunnel, but I believe there are many among you who do not entirely understand its importance, and the great results which must flow from its construction. If you will have a little indulgence with me then, I shall try

to explain to you what the tunnel will accomplish, what has thus far prevented its construction, and show you that by joint action you can easily consummate and carry out what appears to be a gigantic undertaking.

It will become necessary, in the course of my remarks, in order that you may properly understand this tunnel project, to expose some of the doings of an institution called the California Bank. I shall tell the truth, without fear or reservation, for I have come here to "fight it out on this line," and I intend to do so, "though the heavens fall."

About ten years ago, Peter O'Reilly discovered the existence of silver on what is now known as the Comstock lode, the richest silver vein of which there is any record in ancient or modern history. Work during that space of time progressed rapidly, and where it was an easy task to extract the minerals from these mines in the beginning, it is now one of extreme difficulty. They have reached an average depth of probably 1,000 feet, and we find that nearly fifty steam-engines are required to pump out the water and hoist the ore. The expenses of keeping so much machinery in motion is immense, and even at this present time they absorb so much of the profits that it has already become unprofitable to work some of the mines.

It is not only the original cost of the machinery and the enormous consumption of fuel, in a country where no coal exists, but the constant additions, the wear and tear of engines, boilers, cables, cages, &c., &c.; the vexatious delays by breaking down; the lengthening out of the pumps, pipes, and rods; the excavations for and the construction of pump-bobs; the engineers, firemen, and other attendants required; in fact, the innumerable and constant expenses connected with the operation of extensive and heavy machinery, which has to be increased for every foot of descent, and which makes it only a question of time when these mines will have to be abandoned, no matter how rich the ore.

In addition to all this, we find that the heat at the present depth has so much increased that, notwithstanding the improved ventilating apparatus, the men can do but one half the work they could in a cool, healthy atmosphere, and the loss in consequence is more than a million of dollars per annum.

Is it any wonder, then, that these, the richest mines in the whole world, will no longer pay under the present unwise system of working? You are told that in order to make them profitable again your wages must be reduced, and next in succession you will be told that white labor does not pay any more at all, but that Chinese must take its place. If the mines do not pay now, what will be their condition in two or three years from now? If it requires from forty to fifty steam-engines to work them at a depth of 1,000 feet, how many will be required at a depth of 1,500 or 2,000 feet? If the thermometer now stands at 95 or 100 degrees Fahrenheit, and the miners become consumptive for the want of oxygen in the air, and can do but one half their usual amount of work, what will become of them at that greater depth? Will it be possible to work them at all?

I might cite numerous instances of mines in Mexico, and all parts of the world, which had to be abandoned on account of the rapidly increasing expenses as depth was reached, but I cannot go into these details on the present occasion; all I can say to you is, that experience in all places and at all times has shown that mines at some time do reach a depth *where the constantly increasing cost of mining exceeds the yield*, and hence we find that during several thousand years of mining operations, even by means of tunnels and other auxiliaries, the greatest depth that has yet been reached on any mine in the world is but 2,700 feet.

The laws of nature and of mechanics are alike everywhere, and it is my firm belief that some of the mines on the Comstock lode have already reached a depth where it no longer pays to work them, and that they all will reach that depth before a deep tunnel can possibly be completed. What then will become of the once flourishing counties of Storey, Ormsby, Lyon, Washoe, and Douglas, which almost entirely depend on the produce of these mines? Is it not proper that every good and well-thinking citizen should earnestly reflect upon the fate that would overreach this commonwealth should that great and only source of our prosperity cease to exist?

There would no longer be employment for the miner, the laborer, the mill-hand, the carpenter, the blacksmith, the mason, the teamster. No longer would there be any one to support and patronize your newspapers, groceries, bar-rooms, hotels, livery stables, express companies, assay offices, dry goods, clothing, millinery, drug, hardware, cigar, fruit, and book stores.

Your dwelling-houses would be deserted; your stores without tenants; your real estate valueless; your mills would be idle; no more lumber would be required; your farmers and gardeners would no longer have a market; your State government would commence to totter; the assessor would find his assessment-roll grow gradually less; the treasurer would see his cash account diminish in the same proportion; your State credit would be sadly shaken; the people in the mining districts of the eastern portion of Nevada would have to bear the whole burden of taxation to support the govern-

ment and to pay the interest on the State debt, and bankruptcy, ruin, and desolation would be brought upon a once flourishing country.

This is a sad picture; it is its darkest side; but is it not well, while we are still in a condition to act, while we have sufficient strength left to go to some exertion, while we have the means for self preservation, to look the enemy boldly in the face and devise such means as will avert the calamity?

The only remedy which presents itself, sure and certain in its operations, is the construction of the Sutro Tunnel. The day work is commenced on that tunnel, with a reasonable prospect of completing it, that day you give a new lease of life to this section of country. From that day on you instill new confidence into the future; from that day on your real estate and other property will once more assume a value, and people will no longer say to you, as nine out of ten do now, that they are going to leave the country in a few months.

Great tunnels have been constructed for centuries in all countries where mining is carried on intelligently, and they have accomplished precisely what we desire to accomplish here. I might give you instances of tunnels constructed, three or four times the length of the one proposed here, while they gave but one-sixth the depth; I might relate to you the magnificent results obtained from their completion; I might tell you of the enormous fortunes which were obtained thereby, and give you many other interesting particulars were it not for the want of time to-night.

The Sutro Tunnel, starting at a point near Carson River, will reach the Comstock lode in a distance of 20,178 feet, and cut the same at a perpendicular depth of 1,922 feet, or a depth along the dip of the lode of 2,900 feet below the floor of the Gould & Curry Company's former office. In order to expedite the work, four shafts will be sunk on the tunnel route, from the bottom of which, at the proper depth of the tunnel level, drifts will be extended in each direction. After reaching the Comstock lode, the tunnel will be continued northerly along the lode to and beyond the Sierra Nevada mine, and southerly along the lode to and beyond American Flat.

A very elaborate report was made some time ago by R. G. Carlyle, esq., an engineer of a high order of ability, on the details of construction and cost of the tunnel; his report covers about 200 foolscap pages, is full of illustrations, and in its details altogether a creditable and reliable work; his estimate gives the cost of the tunnel at about \$100 in gold per foot, which, probably, is somewhat below the mark, taking into consideration the unknown difficulties usually encountered in such extensive works; he estimates the time necessary to complete it at two and a half years.

The principal advantages this tunnel will create, as far as mining operations on the Comstock lode are concerned, may be enumerated as follows:

First. All pumping-machinery may be dispensed with as soon as the tunnel is completed, for the shafts now existing on the Comstock lode may at once be connected with the tunnel by boring, which is at the present time accomplished rapidly, and at small expense, thus draining off the water from the shafts and permitting their connection with the tunnel without delay.

Second. The moment this connection is accomplished the most perfect ventilation is insured—drawing off the fumes of powder like a chimney would 2,000 feet in height, cooling the atmosphere, giving health and vigor to the miners, and preserving the timbers.

Third. The mines may thereafter be opened by numerous stations or galleries to the whole depth of 2,900 feet, thus showing the different bodies of ore contained in the mines, exposing many millions of treasure to the eye, and increasing their value in proportion.

Fourth. It will give a great impetus to the exploration of those mines which have thus far been unproductive, particularly those north of the Gould & Curry mine, and those on American Flat, which, to a large extent, have been lying idle on account of the great burden of exploring an unproductive mine through perpendicular shafts.

Fifth. For the reasons already stated, the extraction of ore will be so much facilitated and stimulated that the present production of twelve or sixteen millions of bullion may be increased to, or even be made to exceed, fifty millions of dollars per annum.

Sixth. Not only the pumping-engines may be dispensed with, but also those for hoisting; for after the shafts are connected, instead of hoisting the ore to the surface, and transporting it by means of wagons or railroad to the mills on Carson River, at an expense of at least three dollars per ton, it will fall down to the tunnel level by its own gravity, at no expense at all, while a railroad in the tunnel, but four miles in length, can deliver the ore at the mills on Carson River at an expense of twenty cents per ton.

Seventh. By this great saving in extraction and transportation, and the abolishment of all steam-hoisting and pumping engines, which now eat up all the profits, it will be made possible to take out the immense bodies of low-grade ores, assaying from \$2 to \$20 per ton, and which are known to exist on the Comstock lode, and which may be

concentrated by means of the water which the tunnel itself will furnish. Five hundred millions of dollars, at a low estimate, contained within this mountain, without the tunnel, will forever remain slumbering in the bowels of the earth, for the expenses of extraction, under the present system, are greater than the value they contain.

Eighth. After the completion of the tunnel the mines may, without the use of steam-engines, be worked to great depth below the level of the tunnel, by conducting through pipes the water which may be collected on the surface from melting snow and rains, together with that contained in the mines, to hydraulic engines, or turbines, placed at the bottom of the shafts at the tunnel-level, thus using a portion of the very water which costs so much to pump out at present, as a most economical and useful motive-power to propel pumps, which raise the water from great depths below and discharge it through the tunnel.

Professor Weissbach, the best living authority, gives the power furnished by fifty gallons of water per second at 1,800 horse-power, at a depth of 2,000 feet—more power than all the engines have now in operation upon the Comstock lode. It may safely be stated, therefore, that by means of the Suto Tunnel the Comstock lode may be profitably worked to a depth of at least 3,500 feet—a greater depth than has yet been reached in any mine in the world.

Ninth. Where only 2,000 men are now employed, at wages which may be cut down at any time, after the completion of the tunnel more than 10,000 would find profitable employment on the Comstock lode alone. The cost of mining would be so much reduced that those mines which now barely pay expenses would be enabled to pay regular dividends, and allow liberal wages to the men employed.

Tenth. The construction of the tunnel, giving a future to this country, would enhance the value of all property, restore confidence, and place the affairs of the people on a sound and solid basis.

While the tunnel would create a revolution in operations on the Comstock lode and secure the future of these mines for fifty or a hundred years to come, it will carry with it still more important results.

I now approach a subject which may properly be looked upon as the most important feature of this tunnel enterprise. I refer to the discovery and development of mines along the tunnel route, granted by act of Congress to the extent of 4,000 feet in length on every lode discovered.

The proposed tunnel will penetrate to the very center of this great silver-bearing mountain containing the Comstock lode, and traverses a country chiefly consisting of greenstone porphyry, a formation pronounced by Humboldt and others to be eminently productive of silver mines.

It is a fact well known to every miner that many lodes exist which do not reach up to the surface, and which are usually discovered accidentally, while running drifts or tunnels for some other lode; in miner's parlance, they are called "blind lodes," an expression derived from the fact that they are not visible at the surface. Upon these blind lodes the miner builds his hopes; they give him nerve and perseverance to follow his toilsome labors; their mysterious existence, the wealth which they are presumed to contain, and the uncertainty of their precise location, have a powerful bearing on the imagination of man, and are the levers which induce the undertaking of tasks by even single individuals from which they would otherwise shrink.

In a mineral-bearing region the hopes of discovering and opening valuable mines by running horizontal adits into a mountain are generally well founded; but nowhere on the face of the earth do we find a mountain range containing a vein as valuable as the Comstock lode, and a formation equally favorable for the existence of a series of mines. It is not only reasonable to suppose, but quite evident, that the immense convulsion which rent the earth in twain, and created the fissure which is known as the Comstock lode, at the same time must have cracked and opened the earth's crust in many other places.

These are only theories, but they are theories believed and adopted by every scientific man, and by every common miner, and confirmed by experience. It may, therefore, safely be predicted that the proposed tunnel, which will penetrate to the very bowels of Mount Davidson, will discover and open more treasure and wealth to the east and west of the Comstock lode than were ever before discovered by any work of this kind.

Independently of the large revenue the Tunnel Company will derive from draining the Comstock lode; from the transportation of men, ore, rock, and timber, independently of the great value of the company's land, and independently of any other consideration, the discovery and development of the mines contained in this argentiferous belt would justify the construction of this tunnel, simply as an exploring work, and for that purpose alone it should be looked upon as one of the best planned, legitimate, and promising mining enterprises ever undertaken in any mining district.

And now, fellow-citizens, allow me to give you a short history of my struggles in connection with this tunnel project, and let me explain to you what causes have prevented its success thus far.

On the 4th of February, 1865, the legislature of Nevada granted a franchise, giving

me the exclusive right of way for fifty years, for the construction of a tunnel, commencing in the foot-hills near Carson River, to and beyond the Comstock lode. The charter did not specify any rates for drainage or other services, but left that open to private agreement by the mining companies.

I now invited all parties who wished to do so to join in the enterprise, and an association was formed under the name and style of the Suto Tunnel Company, of which William M. Stewart, our present Senator, was duly elected president. A proposition was submitted to the mining companies "that the Suto Tunnel Company would agree to raise the funds for the construction of the tunnel abroad, in quarters where cheap capital abounds, provided the mining companies would agree beforehand to pay certain rates of charges for drainage and otherwise after the tunnel should be completed and actually benefit them."

When the necessity and importance of the tunnel, and the immense advantages which would be derived therefrom by the stockholders of the mining companies, had been thoroughly explained, which, however, required a number of months, contracts, drawn by some of the best lawyers of San Francisco, were adopted and signed by the following-named companies on the Comstock lode:

Ophir, Central, California, White & Murphy, Best & Belcher, Gould & Curry, Savage, Hale & Norcross, Chollar-Potosi, Alpha, Bacon, Gold Hill Quartz Mill and Mining Company, Confidence, Imperial, Empire, Yellow Jacket, Crown Point, Belcher, Overman, and by several private individuals owning claims.

Under these contracts, the companies agreed, and made the fulfillment of the terms a mortgage upon their respective mines, that they would pay to the Suto Tunnel Company forever, for every ton of pay ore extracted from any part of the mines, whether from the surface or through the tunnel, two dollars, from the time the tunnel or its branches should perpendicularly reach under them, or should actually drain the mines. There were other charges provided for for the transportation of rock, timber, men, &c., &c., which need not be enumerated here; it must suffice to state that, under these contracts, at the rate of production at that time, the mining companies had agreed to pay to the Suto Tunnel Company at the rate of about \$7,000 per day, while these daily payments, after the tunnel should increase the production, were expected to reach \$20,000, and still make a saving of twice that amount to the mining companies, by means of the immense advantages the tunnel would furnish. After these contracts were duly signed, sealed, and delivered, in triplicate, one copy being retained by the mining companies, one copy deposited in the vaults of the Bank of California at San Francisco, and one copy being delivered to the Suto Tunnel Company, I started, as the duly authorized agent of all concerned, for Washington, where I arrived in June, 1866, expecting to obtain from Congress such additional privileges and rights as Congress alone could grant, (the title to all public lands and mines in this section still being in the Government,) and as were considered necessary in order to obtain the required funds for the construction of the tunnel.

After some efforts, a law passed the United States Congress, which was approved by the President of the United States on the 25th day of July, 1866, giving to me, my heirs, and assigns, (in trust for all concerned,) the following important rights:

First. The right of way forever, from the foot-hills on Carson River, to and beyond the Comstock lode, and on any lode which should be cut or discovered by the tunnel.

Second. The title to 1,280 acres of land at the mouth of the tunnel.

Third. The title to all the mines which should be cut by the tunnel, and which were not already owned by others at that time.

Fourth. It compelled the mining companies, those who had signed the contracts, as well as those who had not, to contribute forever the rates of charges named in the aforesaid contracts, and it made their title subject to that condition.

Congress, in this last section, assumes the function of regulation or administration of the mines in an important argentiferous locality, by recognizing the necessity and importance of a deep tunnel and the equitable adjustment of payment therefor. The rates to be paid to the tunnel company might as well have been named in the act, but Congress preferred to simply refer to the rates named in the contracts, as agreed upon by the mining companies, and in consideration of the immense efforts which had already been made, and which were supposed to be required to carry out so gigantic a work, imposed no clause of forfeiture, but declared all the rights granted as vested forever in the grantee.

Thus fortified with a most valuable mining grant, the first one ever made by this Government to an individual, and provided with other privileges worth several millions of dollars per annum, I proceeded to New York, expecting to raise the requisite funds without any difficulty.

The whole merits of the enterprise were fully set forth in a pamphlet published by me and submitted to the first and wealthiest men of that great metropolis, among whom were Commodore Vanderbilt, William B. Astor, and many others, but, in every instance, one obstacle presented itself, and that was, that if the statements made were correct, there could be no difficulty in so magnificent an undertaking to raise some of

the funds, even if it be but a small portion of the sum required, at home, and I soon became convinced that this was the only true course to be pursued. I requested these gentlemen to express their views in a communication to me, which might be submitted to the people of California and Nevada, and, as a consequence, they addressed to me the following letter:

"NEW YORK, October 5, 1866.

"DEAR SIR: We have carefully examined your project for a draining and mining tunnel to the Comstock lode in the State of Nevada, and consider the same an enterprise which, in our opinion, when carried out, will prove of incalculable benefit to the mines on that lode, and at the same time may be a source of large revenue to the parties undertaking it.

"We have taken some pains to ascertain what chances exist in this city to obtain the necessary capital, and have come to the conclusion that you will find it a matter of serious difficulty to convince the people of New York at large of its value; the principal and, in our opinion, fatal objection to its success here at present being the fact that no portion of the capital has been subscribed on your coast.

"If the mining companies on the Comstock lode, and the people of Nevada and California, who are familiar with the value of your mines, would evince their confidence in this enterprise, by subscribing a portion of the requisite capital, say \$400,000 or \$500,000, and work on the tunnel is actually commenced, we think you will find comparatively an easy task to obtain the balance of the funds here.

"We would consequently advise you not to lose any valuable time in futile attempts here or in Europe, where, no doubt, the same objections will be raised, but to return at once to San Francisco and use your efforts there to get the work started.

"Let some of the leading men on your coast, who are known here for their commercial standing and their integrity, form a preliminary board of directors, and you may then, while the tunnel is daily progressing, return to New York, we think, with confidence of success, and we shall use our best efforts to assist you in accomplishing your object.

"Your perseverance and the practical and able manner in which you have presented this laudable undertaking to the public deserve our commendations, and it shall be a source of gratification to us to see your labors crowned with success.

"We are, dear sir, respectfully yours,

"Samuel Willets.

"Daniel T. Willets.

"J. H. De Bevoise.

"John Silsby.

"W. S. Martin.

"Eugene S. Ballin.

"John T. Martin.

"B. Silliman.

"Emil Heinemann.

"Daniel H. Temple.

"J. H. Coghill & Co.

"J. Perry, Jr.

"Polhamus & Jackson.

"Mott & Justh.

"Theodore F. Lewis.

"John T. Daly.

"D. Appleton & Co.

"Wm. Aufermann.

"Z. Dederick.

"J. & H. Greenbaum.

"M. Herzog.

"Moses Taylor.

"Peter Cooper.

"August Belmont.

"J. & Wm. Seligman & Co.

"Eugene Kelly.

"R. C. Fergusson.

"Wm. T. Coleman.

"C. K. Garrison.

"Duncan, Sherman & Co.

"Francis Skiddy.

"Johnson & Lazarus.

"Wm. B. Ogden.

"J. C. Fremont.

"R. L. Cutting.

"David Hoadley.

"C. P. Huntington.

"Geo. A. Freeman.

"Sam'l L. M. Barlow.

"M. Morgan's Sons.

"A. SUTRO, Esq."

It is evident that the persons who signed that letter, representing probably \$100,000,000, looked upon the enterprise as too magnificent altogether, which created the suspicion that something was behind the scenes, and they naturally wanted a substantial indorsement out here.

So, in August, 1866, I concluded to return to San Francisco, in order to follow out the suggestions made in the aforesaid letter, and submitted the matter to the mining companies and to many of the principal merchants of San Francisco.

While this question was under consideration, the legislature of Nevada, which was then in session, passed a memorial and resolutions, asking Congress to loan its credit to this important work, in case sufficient capital could not be secured from private sources, and in a lengthy report set forth its reasons why the nation should feel a deep interest in its execution.

The question as to subscriptions to the Tunnel Company by the mining companies had in the mean time been fully discussed in San Francisco; and after some delay a number of companies agreed to and did subscribe through their trustees sums aggre-

gating together, with subscriptions from private persons, about \$600,000, and there was every prospect of seeing them increased in a few weeks to \$1,000,000 or more in San Francisco alone.

But now commenced the tug of war; at the very moment when I was on the full road to success, when everybody commenced to look upon the whole affair as quite sure of being consummated, and when I myself was led to think that my struggles were about over, they only fairly commenced.

It was at this time that the California Bank ring stepped in, and in high conclave and in secret session concluded that it was high time to break me up, for my efforts were about to be crowned with success, substitute themselves into my place, reap the fruits of my labors, and, by their influence over the politicians of this coast, obtain the aid of Congress which the legislature of Nevada had applied for.

This conclave was held in San Francisco on the 6th of June, 1867, the night before the annual election of trustees for the Crown Point mine; and when that election took place, in which the former president of the company, A. H. Barker, and their superintendent, Batterman, were turned out, and the bank ring took possession, a subscription to the tunnel of \$75,000, which had previously been agreed upon by most of the parties interested, was voted down.

I saw at a glance what was up. The bank, which up to that time had warmly supported me, had now turned against me, and I knew quite well that none of the subscriptions already made by the mining companies would be ratified at their stockholders' meetings. Nearly all the persons who had previously stood by me deserted me; they shunned me on the streets and avoided me as if I had an infectious disease; every miserable cur and hireling of that bank turned the cold shoulder on me—actually afraid their masters might be displeased at seeing them talk to me—and for the first time I commenced to feel and appreciate the immense, overwhelming, and ramified power that concern wields. Men knew, as if by magic, that the bank was now against me; it seemed as if they all had been informed of it at once, and through some invisible power had received their instructions.

It became evident to me that the ring entertained the opinion that their combined efforts must soon crush me out and use me up financially, physically, and mentally, in such an unequal contest. But they had got hold of the wrong man; I was not so easily to be disposed of. When I found that these traitors, after having signed contracts, after having urged and helped me on to expend mine and my friends' money, after having induced me to labor almost day and night for several years, which I did with zeal and enthusiasm—I say when I found that they were determined to rob me of my labors, I made up my mind that they should not succeed in their efforts. I was determined that this base, unscrupulous, and mercenary combination should not carry out its purposes, and made a sacred vow that I would carry out this work if I had to devote the whole balance of my life to it, and defend my rights as long as the breath of life was in me.

I soon found that I had no longer any chances on this coast; I knew that my opponents could easily keep those connected with them, directly and indirectly, from having anything to do with the affair, and also knew full well that by throwing cold water on it, or by declaring it visionary or impracticable, they could prevent those not fully understanding its merits from entering into it, and those who did understand it by bullying and threatening them. And how eagerly did the empty-headed, the brainless, the ignorant, and the envious join in the chorus! this same class who have opposed every great work from time immemorial! this same class who opposed railroads, and steamboats, and telegraphs, and sewing-machines! this same class who opposed and fought the Erie Canal! this same class who a few years ago would ask on every occasion whether you expected to live long enough to see the Pacific Railroad completed!

The difficulties and obstacles seemed to increase and accumulate, and almost appeared insurmountable. How was I to convince people of the contrary, when the most successful men in the country told them not to touch the affair? And how easy was it for them to play upon the prejudices of people when I asked them to invest their money; how easy was it for them to throw out a hint that nobody had any confidence in me?

They found no difficulty in getting the gas and water companies of Virginia City, and all the men under their influence, to tell people the town would be ruined; that it would move down to the mouth of the tunnel; that real estate would become valueless, with many other groundless objections. But did they tell you that without the tunnel the mines would be abandoned and ruin and desolation be brought not only on Virginia City, but upon the whole country?

Fellow-citizens: Have you ever been in a position where your friends shunned you? If you have, you know how mortifying it is on meeting an old acquaintance to have him pass by pretending not to see you, instead of shaking you by the hand and welcoming you. Have you noticed them cross over on the other side of the street when they saw you at a distance? Have you seen their nervous hurry, trying to get off,

when you happened to engage them in conversation? You may possibly have made similar experiences if you were ever broke and your good friends were afraid you might ask them for a loan.

In my case some narrow-minded people may have avoided me, thinking I might urge them to become interested in the tunnel project, but these were comparatively few; the mass of these men knew the bank was against me, and that was sufficient for these servile and timid creatures to insult and avoid me. But I looked upon them with contempt; I had the satisfaction of feeling in my own heart that I was working for a good and noble cause; I knew that the execution of the work I proposed would be a blessing to the men compelled to toil in these mines, and of great and lasting benefit to a whole people. So I continued my efforts, believing that truth is mighty and will prevail, and that in the end my enemies must come to grief, and victory should be mine!

I concluded to give up the field, for the time being, to my opponents, return to New York and go over to Europe if necessary, and see what could be accomplished there. In July, 1867, I arrived at the former place, but soon found that after my apparent failure to raise any funds in California, it was useless to waste my time there. Evidences that the war the Bank of California had commenced to wage against me on the Pacific coast should also extend to New York, came under my observation. On the 16th of July, the day after the Savage Company had held their annual meeting, a telegraphic message was received and a placard stuck up in the office of the agents of the Bank of California in New York, Messrs. Lees & Waller, which stated, in large letters, "That the stockholders of the Savage Company, at their annual meeting, had refused to ratify the subscription made by their trustees of \$150,000 to the stock of the Sutro Tunnel Company, and that the same was utterly null and void."

This telegram was intended to caution the people of New York against me, in case I should falsely represent that the Savage Company had subscribed and ratified their subscription of \$150,000. It was a sort of warning, as if sent ahead of an absconding bank clerk, or forger, or criminal, so that it would utterly ruin my prospects, and coming, as it did, from the leading financial concern of the Pacific coast, it certainly had its effect—it put a damper on my prospects, and I determined to make no further attempt in New York at that time.

It almost appeared to me after this, that the only place where I could vindicate myself, and where the importance and magnitude of the proposed work would be properly appreciated, and where, at the same time, the bank would have the least power to misrepresent and fight me, would be in Congress. But Congress was not to meet until December, and this being the latter part of July, I determined upon spending the interval in Europe for the purpose of examining the mines, visiting their big tunnels, consulting some of their great engineers, in order to lay my experiences before Congress, at the same time paying close attention to the facilities which would exist in Europe for securing the required funds. I was supplied with letters of introduction from many of the bankers of San Francisco, which had been furnished me on my first journey east, among which was one from the Bank of California, signed by William C. Ralston, their cashier and chief manager, to the Oriental Bank Corporation of London, recommending me personally and the tunnel enterprise to their English friends as an excellent investment. This letter, however, I did not of course make use of, after what had transpired, and it remains in my possession now.

I traveled through Ireland, England, France, Belgium, Holland, Prussia, Austria, Poland, Hungary, Bavaria, Switzerland, and Italy, visited many of their mines, was received with great courtesy, and came in contact with many of the leading financial, political, and scientific men of Europe. I descended into their deepest mines—the deepest in the world—and after all my investigations became more and more convinced of two things: 1st, That mineral lodes, true fissure-veins, as shown by all experience, descend downward indefinitely; and, 2d, That in order to work mines rationally and profitably, wherever the topography of the country allows it, great district or main tunnels, which serve as highways under the mountains, must be constructed.

I entered into correspondence and had personal interviews with such men as Von Cotta, the geologist; Weissbach, the engineer; Baron Von Beust, of Saxony; Chevalier, the French senator and political economist; Sir Roderick Murchison, president of the London Geographical Society; John Stuart Mill, member of Parliament; Von Dechens, the friend of Humboldt; Baron Von Hingenau, chief of the mining department of Austria; Burkhardt, Koch, and many others. I submitted my plans to these men, and they unanimously agreed upon the importance, feasibility, and magnificence of the undertaking and addressed to me many complimentary letters.

I found it impossible, however, to raise any funds in Europe for several reasons. In the first place, people there as a general thing have no confidence in our mining laws, as far as security of property is concerned; secondly, they raised the same objection which was raised in New York, that our own people on the spot must first show their confidence by their subscriptions and by commencing work; and, thirdly, at that particular time, if there had been no other obstacle in the way, the threatening

attitude between France and Prussia would have prevented the consummation of any extensive financial operation abroad.

I found but one concern, the house of Erlanger & Co., the great bankers of Paris, who were willing to entertain the project at all; but after sending for one of their London partners, they also concluded it to be impossible to carry out the affair at that time.

So I returned again to the United States, and left Liverpool on the 1st of December, 1867, arriving at Washington just after Congress had met. I now commenced to go to work in good earnest; made the favorable acquaintance of nearly all the members of both Houses of Congress, and the leading men of the nation, and had a fine prospect of success.

It soon became known to the bank out here, through information derived from their spies in Washington, who kept close watch of my doings, that the chances of obtaining a loan from the Government were good, which made them feel quite uneasy, and they immediately sent a number of telegrams to different persons in Washington, one of which reads as follows;

"VIRGINIA, Nevada, January 15, 1868.

(Received at Willard's Hotel, Washington, D. C., January 16, 1868.)

"To Hon. WM. M. STEWART and JAS. W. NYE:

"We are opposed to the Sutro Tunnel project, and desire it defeated if possible.

"WM. SHARON.

"CHARLES BONNER,

"*Superintendent Saracoe Company.*

"B. F. SHERWOOD,

"*President Central Company.*

"JOHN B. WINTERS,

"*President Yellow Jacket Company.*

"JOHN P. JONES,

"*Superintendent Kentucky Company.*

"J. W. MACKEY,

"*Superintendent Bullion Company.*

"THOS. G. TAYLOR,

"*President Alpha, and Superintendent Crown Point.*

"*and Best and Belcher Companies.*

"F. A. TRITLE,

"*President Belcher Company.*

"ISAAC L. REQUA,

"*Superintendent Chollar Potosi Company."*

This telegram was meant to read as follows: "We are opposed to Sutro getting an appropriation for the Sutro Tunnel; defeat him if possible; that will use him up, and we, Wm. Sharon & Co., will then step in and get it." As a matter of justice, I will here state that the superintendents who signed this document could not well have refused it, and I believe that some of them to-day are warm friends of the tunnel enterprise. It was sheer accident that I got hold of this telegram; how many were sent, together with letters and secret instructions, is impossible for me to tell. I may state, however, that the very next day two more messages arrived in Washington, signed by a number of mining presidents of San Francisco, nearly all well-known tools and flunkies of the bank, one of which was addressed to John Conness, whilom Senator from California, who, in his eagerness to serve his masters, did not hesitate to openly oppose me.

They took so deep an interest in my affairs that they expended over \$100 in two days for these telegraphic messages, while the information they contained could have been conveyed in a letter, more fully, at an expense of three cents.

These telegrams I paid but little attention to. The bank may be a big concern here; at Washington it amounts to but precious little. Whether our Senators were much influenced thereby is hard to tell. I asked no favors from them, and started out to make my own fight.

About this time I published a book of about 250 pages, a copy of which I hold in my hand, containing much information about these mines and others; about the interest Government should feel in the production of precious metals, and distributed 1,000 copies among the members of Congress, the leading men of the country, and the principal newspapers. By getting the book up in elegant style, Senators and congressmen kept it on their centre-tables, instead of condemning it to their paper baskets, as is done with many of the ordinary documents sent to them, and if they did not read it at once themselves, their friends did, who, while waiting to get Federal appointments, had not much to do, and ultimately called their attention to it.

I can best give you an idea of the general argument used in the work by reading to you its introductory, which is as follows:

"The development of the mineral resources of this country forms a subject of such

grave importance, one involving considerations of a politico-economical nature of such significant consequences, that it well behooves the American statesman, the patriot who has the future of this great republic at heart, to devote some time to the earnest examination of those questions which have a vital bearing upon the future welfare of this country.

"In the vast regions stretching from the Mississippi River to the broad Pacific Ocean, from the confines of Mexico to the icy regions of the North, there lie buried in the bowels of the earth incalculable treasures of the precious metals, which but await the industrious application of the hardy miner and the fostering care of a provident government to pour out a stream of gold and silver, which will so much increase the national wealth, augment the resources of the nation, and spread welfare and prosperity throughout the extent of this vast land, that the burdens of taxation will gradually disappear, and make the national debt sink into insignificance. If we contemplate that mighty interest, which can be made to create so many blessings, and find that it is neglected and declining from year to year, we must arrive at the firm conclusion that there is something radically wrong in our present system of mining, and that an immediate, practical and effectual remedy should be applied to rescue from a steady decline and eventual abandonment a source of wealth which must be considered the most fruitful and important one this nation possesses.

"If the facts presented in the following pages are carefully examined, three prominent conclusions will be arrived at:

"1st. That the main wealth of the mineral regions is contained in quartz lodes, the principal treasures of which are found at great depths beneath the surface.

"2d. That the present mode of mining downwards from the surface is detrimental to the prosperity of the mining interests.

"3d. That a system of deep tunneling should be inaugurated, which will make mining profitable by giving a natural outlet to the flow of water, by ventilating the mines, by cooling the atmosphere, and by facilitating the extraction of ore.

"Mining requires capital, which the western regions do not possess; the Eastern States have an abundance, but not for investment in mining enterprises, which are looked upon with suspicion and are almost considered disreputable.

"Some years ago many persons were found quite willing to embark in mining ventures, and considerable sums were invested; but the experiences made have been disastrous and ruinous to those concerned, in almost every instance. This result has been charged to various causes, but the true one must be sought in the unwise, extravagant, and wasteful manner in which the work on the mines has been performed.

"The construction of deep tunnels, which by all authorities are admitted to be absolutely necessary to make mining operations successful, requires time, and the outlay of large amounts of capital, and consequently implicit confidence in the permanency of the mines.

"It is the lack of confidence in the permanency of the mines (their downward extent to great depth not having practically been demonstrated in the United States) which prevents the execution of such works.

"The Comstock lode, the most productive of all mineral lodes in the world, producing as much silver as the whole republic of Mexico, presents the most extraordinary example, illustrating the ruinous and wasteful manner of our present system of mining. We have a lode here which has produced within the last six years over \$75,000,000, and the whole of that enormous sum has been swallowed up by the expenses of producing it. The mines upon this lode have now reached such a depth that, after a few years, they must inevitably be abandoned, provided a deep tunnel be not constructed.

"Great mineral lodes, true fissure-veins, according to experiences made in older countries, extend downward indefinitely; we have the testimony of some of the first scientific men living, that the Comstock lode bears the strongest evidence of being a true fissure-vein.

"Here, then, we have a remarkable state of affairs; a lode yielding \$16,000,000 per annum, almost the whole amount being absorbed by the expenses of producing it, while the construction of a deep tunnel, for which extraordinary facilities exist, would leave a large portion of that amount as a profit; the downward continuance of the lode is theoretically, at the same time conclusively, proven, and still we find that capitalists cannot be found to undertake the construction of a deep tunnel, because the ores at great depth are not actually visible.

"Were that tunnel completed to-day, a glorious reality, pouring out a silver stream of \$40,000,000 or \$50,000,000 per annum, these same capitalists, who first want to eye the riches way down in the earth before they consent to invest, would be eager to enter into similar undertakings in all parts of the mining regions, and tunneling would become the order of the day. The nation would be enriched beyond all expectation, and the benefits to the Government and the people would be incalculable.

"That it is both the duty and the interest of the Government to aid in the construction

of one such tunnel to serve as an index-work, and thereby establish the continuance of mineral lodes in depth, cannot admit of any doubt.

"The most favorable opportunity for such a demonstration presents itself in the construction of the proposed tunnel to the Comstock lode; the Government may consistently extend its credit to that work, for almost no risk is involved, the security offered being a hundred-fold. A simple investigation of the subject will prove this conclusively.

"Some thirty years ago a similar question arose in Saxony, when Baron von Herder, then chief of the mining department, as an introductory to a book on the subject, addressed his countrymen in the following words:

"To the friends of their country do I dedicate the plan of a mining work, the execution of which is of the highest importance to the mining interests of Saxony.

"It is the plan to drive a deep tunnel from the level of the Elbe, near Meissen, to the neighborhood of Freiberg, in order to drain the water from the mines of that district to a much greater depth than heretofore, and by means thereof to secure their existence for centuries to come; a plan which as to magnitude, time and cost, is large and gigantic, but which appears in its effects and results so benevolent and full of blessings, that the question as to cost should not form an obstacle to its execution.

"It is true that the resources of the mining treasury of the Freiberg district are too limited to bear these expenses; but the execution of a work which in times to come will be classed in the list of those great national monuments which have for their object the lasting welfare of a country, and which will secure the same for the latest generations and times, cannot be left to the mercy of a single mining district, but should be looked upon as a work creating happiness and glory, and worthy of the participation and promotion of the entire nation.

"With unlimited confidence do I therefore present to the friends of their country the following explanation and statement of this project.

"May they extend to it a wise and sympathizing examination and magnanimous consideration, and may they be assured of the fervent thanks which posterity will grant them."

"The mines of Saxony produced, and now produce, but a mite of what our mines do; the national debt of that country is but small, and the burdens of taxation are not of an onerous character.

"How much stronger, then, should the argument be in the case at issue! A country containing more mines and richer mines than all the balance of the world combined; a country having a national debt amounting to over \$2,500,000,000, and a people crying out and groaning under unequalled burdens of taxation!

"Wisdom and foresight point out but one course; let the mineral resources of the country go to ruin, and the national debt, the burdens of taxation, and general suffering will be increased from year to year.

"Let our immense mineral resources be developed, an increase in the value of all property, a relief of the burdens of taxation, unparalleled advancement of commerce, industry and traffic, a bright future, speedy resumption of specie payments, and general welfare and prosperity will be the results.

"Those who rule the destinies of this country have the solution of this question in their hands; wisdom, foresight, liberality, and true patriotism will grasp the issue, and promptly secure those results which will immensely benefit our present generation, and extend its blessings to posterity."

The Committee on Mines and Mining, fully appreciating the impetus which would be given to the development of our great mineral resources by the construction of this tunnel, after a most thorough investigation, perfected a bill recommending a loan of \$5,000,000, in twenty-years seven-per-cent. bonds, to be delivered at the rate of \$15,000 for every 100 feet of tunnel completed. To show how thoroughly this committee understood the importance of the proposed work, I will here give an extract from their official report, published by order of the House of Representatives, in which they say:

"Your committee considers the execution of *one* great mining work, such as the proposed tunnel to the Comstock lode, as conducive to the most beneficial results; it would practically demonstrate the continuance of mineral lodes in depth, thereby establishing confidence in the execution of similar works in all the mining districts.

"Writers on mining agree on the importance of general drain-tunnels, and the best proof of their utility is shown by the fact that in those mining districts where a general and extensive system of drainage by tunnels has been adopted, the mines have been kept in a flourishing condition during hundreds of years, while in those places where no tunnels have been made, mining operations have proved unprofitable, and the mines have been abandoned.

"We find in all mining codes provisions for the construction of tunnels; they were, in olden times, called 'the keys of the mountains,' and under the laws of Spain, Belgium, Prussia, Austria, Hungary, Saxony, Hanover, and other countries, compulsory payments toward the support of drain-tunnels were exacted from the mine owners, in order to keep up the mining districts.

"Gamboa, the great expounder of Spanish mining law, in speaking of the neglect of the justices to enforce the construction of tunnels, says:

"By indulging in this neglect of their duty they do injustice to the public, to individuals, and to the rights of the Sovereign, who has made it a law that the working of the mines shall be assisted by means of tunnels, as being works of great importance, and necessary for giving a permanent character to this valuable description of property."

"General drain-tunnels are important in many regards; they not only provide the cheapest and safest means of drainage, ventilation, extraction and discovery of ore, but they accomplish the great and very important result of consolidating the different interest in a mining district, by establishing one general base of operations.

"As mines are worked now, the proprietors or companies, on a mineral lode—no matter how limited the extent of the claims—each, independently of their neighbors, erect a steam-engine, pump the water from their mines, hoist the ore, and transport it to the reduction works; they boast of independent organizations, presidents, boards of trustees, superintendents, secretaries, &c., kept up at an enormous expense, which makes mining unprofitable and a losing business.

"In large cities we find it necessary to establish a joint system of drainage, gas and water works. Main sewers are constructed, into which small branches enter from every building. Supposing each house-owner were to provide his own drainage, independent of his neighbors, establish his own gas manufactory, and dig a canal of his own from a distant spring, in order to get a supply of water, the world would pronounce such proceeding very unwise and foolish.

"And still we find a similar state of affairs in our great mineral districts; a contiguous row of mines on the same lode, each worked independently and entirely regardless of its neighbors, while one general tunnel, or adit, or drain, would allow the water to run off by its natural flow to the lowest level, from all the mines, through one common outlet, thereby abolishing at once all pumping-machinery, giving one common railroad for the transportation of all the ore, and creating innumerable advantages. Only one general mining administration would be required, operations could be carried on jointly and systematically, the extraction of ore largely increased, the health of the miners secured by good ventilation, and large sums of money would be saved, thereby making it possible to extract immense bodies of low-grade ores.

"In short, instead of an unwise, short-sighted, ruinous, and stupid manner of proceeding, we would inaugurate a rational system of mining, a system which would make it profitable, attract the capital which is absolutely necessary for the development of this branch of industry, increase the production of the precious metals beyond all expectations, populate the vast extent of our mineral regions, procure traffic for our trans-continental railways, stimulate the commerce and industry of our whole nation, firmly establish our credit by proving the extent of our mineral wealth, and, above all, relieve the burdens of taxation by increasing the value of all property.

"Such are some of the advantages which, in our opinion, would be derived from the adoption of a general system of tunneling in our great mining districts; and it must appear remarkable that such tunnels, their advantages being so self-evident, have not already been constructed in numerous places."

The measure grew more and more popular, in spite of the secret efforts of the California Bank, and would, no doubt, have passed with a three-quarter vote of the House, had it been possible to reach the Committee on Mines and Mining in the regular order of business.

Unfortunately, when we were almost within reach of the bill, the impeachment trial of Andrew Johnson commenced, and before its weary length was terminated, it was so late in the session that our committee never was reached at all, and consequently the tunnel bill had to go over.

Congress adjourned late in July last year, and I returned to California somewhat disgusted with my ill luck, but never for a moment losing my confidence in ultimate success. Before I left Washington many letters were addressed to me by members of Congress, expressing their regret at my bill not having been reached, and giving it as their opinion that at the next session it would certainly pass. Among these was one from Thaddeus Stevens, one of the very best friends the measure had, who stated that at the next session he would warmly support it; but the old man did not live to see another session; he died within a fortnight.

After spending a few weeks at New York I returned again to California, from whence, after remaining a couple of months, I once more proceeded to Washington to renew my efforts.

In the mean time General Grant had been elected President of the United States, and the misunderstanding which existed between him and Andrew Johnson prevented any special legislation, which, as was stated, might embarrass the former's administration. So Congress concluded to enter into no legislation whatever, with the exception of the passage of some appropriation bills necessary for the support of the Government, and thus the Fortieth Congress expired without acting on my bill.

The new Congress convened on the 4th of March last, under good auspices, and

General Grant, in his inaugural, referring to the payment of the national debt, alludes to the importance of developing our vast mineral resources, and speaks of the treasure-chest which Providence has provided us, buried in our western mountains, for which we must forge the key now to unlock. After a short session of a few weeks Congress adjourned until next December, when, for the first time, I expected to get a fair chance to bring my bill up and have it thoroughly discussed.

I have but little doubt but that, notwithstanding the great efforts the California Bank will make to control the action of both our Senators, they will firmly stand by the people, and use all their influence for the accomplishment of this great work.

In the mean time I have come out here among you, my fellow-citizens, in order to explain to you all about this tunnel business, and while some of the moneyed men of San Francisco look upon the whole thing as a failure, not knowing anything of its history, nor of the great fight of the California Bank ring against it, and which erroneous opinions also many of you entertained, I have more confidence in its success now than ever.

Fellow-citizens, I have come among you to propose to the working people of Nevada to join in together in order to start work on the tunnel itself, and thereby give me that solid indorsement at home, from those who live on the very spot, from the men who work in these very mines, and who are supposed to know most about it, which I have lately sought in vain from the mining companies and from the people which should be most deeply interested. Your solid indorsement will be valued highly at Washington; it will annihilate the efforts of that scheming combination, the California Bank.

Fellow-citizens, it must now be evident to you that the arch enemy of this great work is that hydra-headed monster you have reared in your midst, and allowed to grow into gigantic proportions; that enemy of that welfare of the whole Pacific coast; that incubus upon your prosperity; that crafty concern which resorts to every means to carry out its ends. And why do they oppose the tunnel? Why do they all in their power of cunning and scheming and planning to defeat it? Why are all their satellites and hirelings told they must defeat and oppose the tunnel project with all their might and power, by fair and by foul means? Why do they threaten to discharge their employ  s if they take a hand in it? And why are they compelled to do all this in the darkness of night? Why is it they dare not make their motives known?

Fellow-citizens, let me enlighten you. Allow me to pierce that darkness and let in a ray of day-light; let me explain to you why these men so bitterly oppose a work which in them, the ostensible owners of the Comstock lode, should find the strongest advocates; let them show to you why they have turned to be the guardians of the Treasury at Washington; let them tell you why they tremble with fear lest work on the tunnel be started; let me explain to you why they make you work in a foul atmosphere, which sends half of you to your graves in the prime of manhood; let me show you why they have allowed forty-two of your miners to be foully murdered at the fire of the Gold Hill mines for the want of an exit through the tunnel; and let me show them to you in their true colors, and then hold them up to the shame, contempt, and ignominy they so richly deserve.

In order to do so I must enter into the details of some of the operations of this clique which rules and controls these mines, and apparently are the absolute owners of a controlling interest in this vast and important property.

Many of you will be utterly astonished to learn that neither the bank nor the mill ring, as a general thing, own more than a few shares in each mine—just about enough to be elected trustees of the companies, while you, the miners and residents of Virginia City, do always own a large amount of stock, and sometimes a controlling interest, in many of the mines. I do not wish to say that the bank ring has not at different times owned large amounts of stock for a number of months, but that was only in such mines as the Savage and Kentuck, for instance, during the years 1867 and 1868, as were then in a magnificent condition, and paying large and regular dividends. But you will say, How is it possible that they can control the elections, put in men of their own ring as trustees, and manage and manipulate these mines as they please, to further their own ends, if they do not own any stock?

That is precisely where the secret lies, and where the public gets gulled and swindled and humbugged, and allows this clique, by sharp practice, to carry out its nefarious schemes.

You all know that there is an institution in San Francisco called the Bank of California; they have a branch house in Virginia City, over which William Sharon presides. The principle upon which this concern is carried on is to get deposits from as many people, and in as large amounts, and from as many quarters as possible; that is where their power lies! Their capital stock is \$5,000,000, with which they do a business of many millions more. They loan out a great deal of money; whether they loan out any of their depositors' money we don't know; but they loan out a great deal; they loan a great deal to their individual members, who are engaged in extensive speculations; some of them pay, but a great many do not; that money is scattered all over creation, and whether it is probable that they could pay all they owe, should they be called upon, I doubt very much. Money in a good iron safe, or

deposited in some of the solid banks of San Francisco, might be a great deal securer. I shall, however, revert to this more in detail on some future occasion.

Among other things, they loan money on mining stocks. The Virginia agent keeps the San Francisco bank well posted on the value of each particular mine, and on the special manipulation going on in it; daily telegrams and letters are sent on the reports of special experts kept for that purpose. This information, which is withheld with the utmost secrecy from the public, enables the San Francisco concern to advance money on stocks, and to brokers, without much risk, while no other bank or moneyed institution dare touch it. Now let us see how this operates; all men who deal in these stocks are more or less of a gambling disposition; they put in a little money and want to make a great deal; they almost always go beyond their means; they buy a certain number of shares, carry them to their broker, or to the Bank of California, borrow as much money as they can get loaned on them, in order to enable them to buy more, and are compelled to transfer their shares—not to the bank, for that would make it responsible for any debts which might be contracted by the mining companies, but to one of their irresponsible clerks, A. E. Hill, for instance, whose name figures quite extensively in the delinquent lists, and whose name only stands for that of so many miners or other individuals. Thus that bank clerk has a large amount of stock standing in his name, without owning a share, and no outsider knows whose stock it is. This is one way the bank obtains control of a large amount of stock both at San Francisco and at Virginia; but by far the greatest part comes under their control in a still easier way. Most of you miners and others who speculate in stocks go to a broker, deposit your money and get him to telegraph to his partner in San Francisco for a given number of shares in a certain mine; the purchaser here never sees that stock; it is issued in the name of the broker, for to issue it in the name of the purchaser causes delay, inconvenience, and expense. Many of these brokers receive accommodations from the bank, and are consequently under obligations to them; many others are simply convenient stool-pigeons in the hands of the bank ring. Now what is the result of all this? When the annual election comes off in a mining company the managers of the bank hold a sufficient amount of stock in their hands as collaterals, together with the proxies they obtain from brokers, who represent the miners and others, so that they can almost invariably step in to an election and cast this vote for a set of trustees which have previously been made up in the back office of the California Bank. And who are these trustees? About a dozen of them compose the trustees in nearly all the mining companies, and a majority in each company are either under the thumb of or mere tools of the bank, and if you were to examine the books you would find that most of them do not own more than three or four shares apiece. And these few miserable shares even do they not in many instances own at all, but they are simply loaned them, and transferred to their names so they may act as trustees. Those are the men whom you allow to manage your property. In order to throw sand into people's eyes, one or two trustees are usually elected who bear a high reputation for integrity; and so adroitly are the affairs of most of these companies managed between the majority of the trustees, the president of the company and the superintendent, that the minority of the board often do not suspect even that anything is wrong, and thus lend their names to the most nefarious schemes for entrapping the public.

In some instances the bank ring cannot obtain sufficient stock in the manner indicated, and then they are compelled, although reluctantly, to purchase a sufficient amount temporarily to make up a majority until after the election. To show how much value is placed in getting the management of a mine, considering that the trustees receive no salary, you need only look back to the election of the Hale & Norcross a little over a year ago, when the bank ring paid as high as \$16,000 per foot, while the true value of the stock was less than \$2,000.

In this manner the ring, without owning a share of stock, or but very little, obtain the management of these mines and become your masters, while you are, to a large extent, the owners of the property. They become the absolute tyrants who rule over you, and threaten to discharge you if you do not dance according to the tune they fiddle. They arrogate to themselves the power and dictate to you, the proprietors of these mines, what shall be done; they regulate the amount of your wages; employ and discharge you as they see fit, and even threaten to turn you all out and employ Chinese in your stead. Of course, they lose no opportunity and embrace every occasion to impress you with the pretended fact that they own a very large amount of stock in all these mines. Go and examine the books, convince yourselves, and then wonder how such unblushing falsehood, based on brass and impudence, could have existed so long and not be exposed.

Now let us see how their control of the mines further operates: there is a concern called the Union Mill and Mining Company, supposed to be composed of just about the same men as control the California Bank and the mining companies. At the head of that concern, at Virginia City, is the agent of the California Bank. Somehow or other this mill association has gobbled up all the valuable mills in the neighborhood, and, as is stated, by paying but a very small portion of the cost of them. Most of

tunnel done, a glorious fact, and see how small all such objections will look. If there is a motive to begin the tunnel, how much greater is it to finish it. The whole secret lies in starting it going. Get the sharp end of your wedge fairly inserted, then drive away, and every blow will tell.

Come forward, then, and subscribe your names; pay in your money promptly. If you can spare but \$5 this month, go up to the office and put it in. Some of you will put in \$100. We have sufficient money in the treasury now to commence work within a few days. Come at once, then, and you will prove your friendship for the cause.

If my individual efforts have been sufficient to induce many of you to come in, how much greater will be our influence and strength when several hundreds, or even thousands, are interested. How much greater will be our influence at Washington, and how much greater the chance of obtaining the subsidy asked for.

Do you have any fear the work will ever stop again after it once starts? I have none myself. When that tunnel is daily progressing, with chances of striking rich veins at any hour, everybody will want to invest; everybody will then be the friend of the enterprise. When people see it is going to go, they will all say they knew it would. You will no longer be able to find any one who ever opposed it; the newspapers will all come out for it; the excitement will run high, and in a very short time people will be eager to invest at double or triple the price.

So much, then, for the dollars and cents view of the question; but let me revert once more to the other, which is by far the most important.

Supposing, then, your contributions were outright gifts to the cause, would you be the loser? I think not.

Miners and laboring men, what is the price of your health, your liberty, your independence? Are they not worth more than all the filthy lucre you could possess? Who is there among you so avaricious as to refuse to give and donate outright a few paltry dollars per month to a cause which will elevate your race, secure your health, your liberty, and your independence? A cause which will insure to you liberal wages; a cause which will effectually settle that vexed Chinese question; a cause which will make you the power of this land, make powerless your oppressors, and break up your arch enemy, the California Bank. I say, who is there so blind as not to see the magnitude of the question?

Let a noble rivalry spring up among you who shall come in first; drop all prejudice; let all trifling objections fall to the ground; let one excel the other in magnanimity; let all make one joint, grand, unanimous effort, and victory will be ours.

